Baseline Ecological Risk Assessment Of the Former ARMCO Hamilton Plant Site

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List of Acronyms

AHP	Armco Hamilton Plant
AOC	Area of Concern
AVS	Acid Volatile Sulfides
AWQC	Ambient Water Quality Criteria
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive, Environmental Response, Compensation and Liability Act
Cm	Centimeter
COG	Coke Oven Gas
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
DNR	Department of Natural Resources
EPC	Exposure Point Concentration
EqP	Equilibrium Partitioning
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ESL	Ecological Screening Level
ESV	Ecological Screening Value
FOD	Frequency of Detection
GMR	Great Miami River
HCP	Hamilton Coke Plant
HQ	Hazard Quotient
IBI	Index of Biotic Integrity (IBI)
ICI	Invertebrate Community Index
LEL	Low Effect Level
MDL	Method Detection Limit
MIwb	Modified Index of Well-Being
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OMOE	Ontario Ministry of the Environment
ORNL	Oak Ridge National Laboratory
PAH	Polycyclic Aromatic Hydrocarbon
PBT	Persistent, Bioaccumulative and Toxic Compounds
PCB	Polychlorinated Biphenyl
PFS	Problem Formulation Statement
QCTV	Qualitative Community Tolerance Values
QHEI	Qualitative Habitat Evaluation Index
RAAD	Risk Assessment Assumptions Document
RI/FS	Remedial Investigation/Feasibility Study
ROC	Receptors of Concern
SEM	Simultaneously Extracted Metals
SLCOPC	Screening Level Chemical of Potential Concern
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific /Management Decision Points
SQL	Sample Quantitation Limit
SRV	Sediment Reference Value
SVOC	Semi-Volatile Organic Compound

TCDD	Tetrachlorodibenzodioxin
TCDF	Tetrachlorodibenzofuran
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalent
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
tPAH	Total Polycyclic Aromatic Hydrocarbons
USDOI	United States Department of Interior
U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compound
WHO	World Health Organization

Executive Summary

KEMRON Environmental Services, Inc. (KEMRON) has conducted a baseline ecological risk assessment (BERA) in support of an Administrative Order on Consent (Order; EPA Docket No. V-W-'02-C-692) pursuant to the Comprehensive, Environmental Response, Compensation and Liability Act of 1980 (CERCLA) for a Remedial Investigation/Feasibility Study (RI/FS) at the former ARMCO Hamilton Plant facility (Site) in New Miami, Ohio. As part of the Site Remedial Investigation, this BERA provides an evaluation of the potential risks to ecological receptors posed by chemicals of potential concern (COPCs) in environmental media at the Site. The results of the screening level ERA (SLERA), concluded that on-site ecological risks were insignificant. However, additional ERA activities were warranted to better understand the potential for ecological risks associated with endemic species (benthic invertebrates and fish) exposure to surficial sediments in the Great Miami River (GMR). The surface soils of the adjacent riparian floodplain (AOC 22) were also identified as requiring investigation. A significant surface soil, sediment and biological community assessment sampling and analysis effort was completed to address data gaps associated with potential ecological receptors in AOC 22 and the GMR.

The Great Miami River is an industrialized River that has historically received and continues to receive point source discharges of industrial and municipal wastewater as well as non-point sources such as stormwater runoff. The accumulation of chemical pollutants such as PAHs, metals and PCBs in the sediments of rivers flowing through populated and industrialized areas is well documented and the GMR is an example of such a river. Select metals, PAHs, and PCBs are present throughout the river (including Upstream of the Site) at concentrations above ecologically based low effect values.

Sediment sampling in the GMR was initially conducted in 2005 with supplemental sampling performed in 2007 in support of refining the understanding of the potential for site-related impact to the ecology of the GMR. The additional sediment data resulted in conclusion that there were impacted sediments upstream as well as adjacent to and downstream of the site. Sediment samples located to evaluate the potential for AOC 7 surface water and AOC 13 groundwater discharge into the Great Miami River indicate that COPCs associated with these AOCs are not elevated within the river sediments in these areas. In addition, the samples located in the vicinity of the tar-like materials in the floodplain (AOC 22) did not contain significantly elevated levels of PAHs indicating that the tar-like material is not significantly impacting the river. This sediment sampling effort achieved confirmation that the GMR is a historically and currently industrialized river and chemical impacts in sediment exist. As a result, it was determined that a fish and macroinvertebrate survey be conducted to determine if the ecology of the system was measurably impacted by residual COPCs in GMR sediment (site-related or otherwise). The presence and measurement of COPCs in GMR sediment indicate the potential for ecological risk and the need to collect additional lines of evidence to support conclusion regarding such risk. USEPA, OEPA and AK Steel agreed that direct measurement of endemic populations was the most direct approach to quantifying the potential ecological risk associated with sediments of the GMR upstream, adjacent and downstream of the site.

The direct measurement of endemic populations in the river and the quantification of community health via the development of Community index scores, Qualitative Habitat Evaluation Index (QHEI) scores, and applicable ecoregion biocriteria values for the GMR upstream, adjacent and downstream of the site was conducted in 2007. It was determined that the AK Steel Hamilton Site appears to have little or no impact on the aquatic community in adjacent portions of the GMR. This was demonstrated by the fact mean Index of Biotic Integrity (IBI), modified Index of Well-Being (MIwb), Invertebrate Community Index (ICI)) and median Qualitative Community Tolerance Values (QCTV) scores among all potential impact locations attained or suggested attainment of the established biocriteria. Adjacent and downstream index scores were generally similar to the upstream reference site. In addition, based on mean IBI and IWBmod scores and actual ICI scores, the fish and benthic communities at two of the four potential impact locations met the narrative classification for very good (OEPA 2006b) and met all exceptional warmwater habitat (EWH) biocriteria. Per OEPA guidance, if the results of these indices indicates that performance expectations for the near-Site reaches of the river (as outlined in OEPA guidance and administrative code (OAC 37456-1-07, Table 7-17)) are met (i.e., full attainment of a designated use, no substantial difference from upstream reference conditions), then no additional ecological risk analysis is warranted in the GMR.

The only persistent, bioaccumulative and toxic (PBT) compounds in AOC 22 soils and GMR sediment above background are mercury and PCBs. Based upon the ecological data collected, PBTs are not considered a significant threat in the GMR or AOC 22 as a result of site activities or releases to the River. A food-web analysis of PBTs (i.e., PCBs) is not considered warranted based upon: 1) the presence of upstream sources of PBTs as identified in upstream sediment samples, 2) a limited presence of PBTs in sediment samples adjacent to the site or potentially site-related, 3) the limited presence of PBTs in site soils adjacent to or near the River (AOC 22), 4) low quality ecological habitat in AOC 22, and 5) the integrity of the benthic biological community in the GMR. The on-site soils do not present a mercury or PCB ecological risk and population level reproductive effects were not observed in the biological community assessment of the GMR (Appendix B). PCBs detected below the Ecological Screening Value (ESV) and infrequent detections of mercury in AOC 22 (floodplain) soils in between the site and the GMR are not considered site-related or significant.

Soils of AOC 22 reveal the presence of similar compounds (low levels of inorganics, PAHs and PCBs) found in GMR sediments. It is not known if the compounds are a result of historical site release, background conditions, or deposition during a high water event in the GMR. The concentrations present are low, often at low frequency and the compounds (aside from mercury and PCBs addressed above) are not considered bioaccumulative or of significant threat to the GMR food web. The presence of low levels of COPCs along the river may represent background conditions of the river system and be the result of sediment redistribution in the river during storm events. Further quantification of ecological exposure and risk above background as a result of these common contaminants along a River floodplain when similar risks have been shown to not be present on site or in the adjacent river, is not warranted.

The presence of organic and inorganic COPCs above probable effect screening values in GMR sediment resulted in a biocriteria survey that was conducted to evaluate the potential impacts that these stressors might be having on the macroinvertebrate and finfish community. The results indicate that the former ARMCO Hamilton plant site has not adversely affected the biological communities in adjacent and downstream portions of the GMR. No further assessment of sediment or riparian soil data in or near the GMR is anticipated as a result of the available data and a conclusion of "no effect" that resulted from the quantitative evaluation of sediment dwelling organisms (macro invertebrates) and fish in the GMR. OEPA review of the Work Plan for this effort resulted in approval for AK Steel to "consider a "no effects" survey result as an off-ramp to further investigation of the Great Miami River for this site" (OEPA, 2007c).

Based on the body of data presented in this ecological risk assessment, including, but not limited to, the absence of threatened and endangered species at the Site; the documented absence of impact to the river biota and achievement of exceptional warmwater habitat biocriteria in the river; documented upstream sediment concentrations of COCs; absence of significant or high quality ecological habitat within the riparian area; and, absence of significant PBT detections in the study area, no significant ecological risk is present to warrant additional evaluation or action at the Site. Therefore, it is concluded that no further ecological investigation of or response action for the AK Steel Former ARMCO Hamilton Plant facility or the Great Miami River is warranted for this site under CERCLA and the NCP.

1.0 Introduction

On April 29, 2002, the United States Environmental Protection Agency (U.S. EPA) and AK Steel Corporation (AK Steel) entered into an Administrative Order on Consent (Order; EPA Docket No. V-W-'02-C-692) pursuant to the Comprehensive, Environmental Response, Compensation and Liability Act of 1980 (CERCLA) for a Remedial Investigation/Feasibility Study (RI/FS) at the former ARMCO Hamilton Plant facility (Site) in New Miami, Ohio. Figure 1-1 presents the Site locus.

KEMRON Environmental Services, Inc. (KEMRON) has conducted a baseline ecological risk assessment (BERA) as part of the Site RI. This ERA provides an evaluation of the potential risks to ecological receptors posed by chemicals of potential concern (COPCs) in environmental media at the Site. The ERA process at the Site has been conducted in several tiers or phases of work in accordance with the RI/FS Support Sampling Plan Work Plan (ENSR, 2005) and the Ecological Risk Assessment Supplemental Work Plan (ENSR, 2007) and in accordance with U.S. EPA Region 5 risk assessment guidance (www.epa.gov/region5/superfund/ecology). The BERA, was conducted in accordance with the following State and federal guidance:

- State of Ohio DERR Ecological Risk Assessment Guidance document, April., 2008,
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final, June 5, 1997: EPA 540-R-97-006),
- U.S.EPA Guidelines for Ecological Risk Assessment (Final, April, 1998: EPA 630-R-95-002F),
- Framework for Ecological Risk Assessment (U.S. EPA, 1992);
- U.S. EPA Region 5 ecological risk assessment guidance website (http://www.epa.gov/region5/superfund/ecology/index.html);
- Intermittent "ECO Update" Bulletins of U.S. EPA; and,
- Draft Final Risk Assessment Assumptions Document for the Baseline Ecological Risk Assessment of the Former ARMCO Hamilton Plant Site (KEMRON, 2008).

The results of the screening level ERA (SLERA) (ENSR, 2008), as approved by Ohio Environmental Protection Agency (OEPA) in May 05, 2008 and USEPA in July 08, 2008 correspondence, indicated that additional ERA activities were warranted to better understand the potential for ecological risks associated with benthic macro invertebrate exposure to surficial sediments in the GMR and in the surface soils of the adjacent riparian floodplain (AOC 22). As described in Appendix A and B, and approved by OEPA and USEPA, a significant sediment and biological community assessment sampling and analysis effort was completed to address data gaps associated with potential ecological receptors in the GMR identified as a result of a SLERA conducted for the Site. This field work was conducted in accordance with methods specified by the OEPA in their Biological Criteria for the Protection of Aquatic Life guidance manuals (OEPA, 1987a; 1987b; 1989a; 1989b), and other OEPA guidance documents referenced in Appendix B. USEPA and Ohio EPA review of the Work Plan for this effort resulted in approval for AK Steel to "consider a "no effects" survey result as an off-ramp to further investigation of the GMR for this site" (OEPA, 2007c). Based on OEPA concurrence with the results contained in Appendix B (OEPA, 2008d), no further investigation of the GMR is warranted to evaluate ecological impact to the river from the site under CERCLA and the NCP.

The approach to the evaluation of potential ecological risks associated with AOC 22 were developed in a Risk Assessment Assumption Document (RAAD) at the request of OEPA. While it was not finalized, with the agreement of USEPA and OEPA, the need to expedite the project progress resulted in moving forward with the BERA without formal approval of the RAAD. The approach provided in the Draft Final RAAD is the basis of this BERA. Additionally, KEMRON and AK Steel noted that the remaining questions raised by OEPA regarding the Draft Final RAAD would be addressed by proceeding with the BERA in conformance to OEPA and USEPA ecological risk guidance. This document has been designed to conform not only to OEPA and USEPA guidance, but also to the RAAD and to address the remaining comments that OEPA had during its review of the RAAD.

The ecological data gathered supports the equivalent of a Level III Baseline Ecological Risk Assessment for lotic systems under OEPA guidance (OEPA, 2008a) where, based upon field observations, adverse effects to populations of representative species that have been shown to be potentially impacted in lotic systems can be more thoroughly evaluated using biological data as additional lines of evidence to support a more robust weight-of-evidence conclusion regarding ecological risk at the site. The results of this effort and the associated conclusions regarding the potential for ecological risk in the GMR are the focus of this BERA.

In accordance with the U.S. EPA guidance and process documents, as well as OEPA guidance, the principal components of the BERA include:

- Problem Formulation: In this phase, the objectives of the ERA are defined, and a plan for characterizing and analyzing risks is determined. Available information regarding stressors and specific sites is integrated. Products generated through problem formulation include assessment endpoints and the CSM.
- Risk Analysis: During the risk analysis phase of work, data are evaluated to characterize potential ecological exposures and effects.
- Risk Characterization: During risk characterization, exposure and stressor response profiles are integrated through risk estimation. Risk characterization also includes a summary of uncertainties, strengths, and weaknesses associated with the risk assessment.

U.S. EPA's Ecological Risk Assessment Guidance for Superfund (U.S. EPA, 1997) expands the primary components listed above and presents an eight-step process for assessments specific to Superfund sites (Figure 1-2). The basic elements of the eight-step Superfund process, as well as the accompanying scientific/management decision points (SMDPs) are consistent with the three-step framework.

1.1 Site Description

The Site includes the property located at 401 Augspurger Road, Butler County, Ohio, which is approximately 252 acres divided between two parcels of land immediately adjacent and to the south of Augspurger Road (southern parcel) and immediately adjacent and north of Augspurger Road (northern parcel). Figure 1-1 presents the Site location. The southern parcel is bordered to the east and south by the Great Miami River, which is the focus of this BERA. The southern parcel, now vacant, formerly contained the Hamilton Coke Plant (HCP), two blast furnaces for ore making, a sinter plant, and associated coal handling facilities. Very little evidence remains of the HCP and the blast furnace area, which were decommissioned/demolished in 1988-89 and 1993-95, respectively. The roadway through the property remains and a large hilly area exists on the western side of the property where the blast furnaces were located. Some concrete slabs remain, indicating where buildings and a large gas collector were located. The majority of the Site is covered with tall grass and occasional trees. This parcel is surrounded by a chain-link fence and remains locked.

The Great Miami River (GMR) forms the southern and eastern boundary of the Site. This tributary of the Ohio River is approximately 170 miles long, and drains a significant portion of southwestern Ohio (drainage area = 5,385 square miles), eventually discharging into the Ohio River. The watershed is generally characterized by flat to gently rolling terrain underlain by glacial till and rich soils. Agriculture is the dominant land use within the watershed, with residential, commercial, and industrial uses covering a significantly smaller portion of the watershed.

Most of the Great Miami River is classified by the OEPA as a Warmwater Habitat, supporting "typical" warmwater assemblages of aquatic organisms. According to the Friends of the Great Miami (www.fogm.org), the river is home to 114 fish species, 297 macroinvertebrate species, and 37 freshwater mussel species. As a result of the watershed's glacial deposits, the Great Miami River flows over a buried aquifer with thick deposits of sand, gravel, cobble, and boulders. In the vicinity of the Site, much of the shoreline is gravel and cobble, with gravel bars exposed during low flow.

An adjacent riparian floodplain (AOC 22) that exists along the site at the river's edge was identified as an area of concern as a result of the SLERA. The AOC 22 habitat is typical floodplain along the river's edge and includes sandy soils with observable areas of flood impact in low-lying areas of vegetation. The slope of the hill between the site and the floodplain/river is significant. Debris consisting of brick, stone, wood and similar materials, is present in a number of areas along this slope and as a result of the slope and debris, there is limited desirable habitat for ecological receptors. The slope does contain large trees and some shrub that may support avian and small mammal species. The physical limitations of AOC 22, however, as a result of the slope, construction debris and flooding have the potential to limit the ecological community in this area.

Additional detail regarding the site description, history, and past operations can be found in the SLERA (ENSR, 2006a) and the Remedial Investigation Report, Revision 2 (KEMRON, 2008).

1.2 Document Organization

The remainder of this document is organized in the following manner:

- Section 2 presents a brief summary of conclusions reached in the SLERA;
- Section 3 presents additional detail regarding BERA problem formulation;
- Section 4 presents additional detail regarding BERA risk analysis;
- Section 5 presents additional detail regarding BERA risk characterization;
- Section 6 presents additional detail regarding the uncertainty analysis in the BERA, and
- Section 7 presents the references cited.
- Appendix A presents sediment chemistry data collected as part of the ERA Supplemental Work Plan.
- Appendix B presents the GMR macro invertebrate and fish assemblage sampling and analysis data.
- Appendix C presents site surface soil data collected as part of the RI/FS Support Sampling Plan Work Plan (ENSR, 2005) and Supplemental Remedial Investigation Work Plan (ENSR, 2008, modified by KEMRON, April 28, 2008).
- Appendix D presents site soil pH data.
- Appendix E presents ProUCL Version 4.0 95% Upper Confidence Levels (UCLs) model statistical output.
- Appendix F presents the site specific background data evaluation per USEPA guidance (USEPA, 2002).

2.0 Screening-Level ERA (SLERA)

As specified by USEPA and OEPA guidance, the first step in the ERA process is a screening-level ecological risk assessment (SLERA) in which the objective is to identify and document conditions that do *not* warrant further evaluation in a more refined baseline ERA. As defined by the USEPA, a SLERA is a simplified risk assessment that can be conducted with limited data where site-specific information may be incomplete and assumed values are used to evaluate potential exposure and effects (USEPA 1997). For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, for exposure and toxicity or effect parameters for which site-specific information is minimal, assumed values, such as area-use and bioavailability, should be consistently biased in the direction of overestimating risk. This ensures that sites that might pose an ecological risk are studied further. A SLERA is deliberately designed to be protective in nature, not predictive of effects. If any potentially significant exposure pathways are indicated from the SLERA, then these pathways are further evaluated in a more refined BERA.

Three possible Scientific Management Decision Points (SMDPs) can be reached following the SLERA:

- There is enough information to conclude that ecological risks are low or non-existent and there is no need to clean up the site on the basis of ecological risk; or
- There is not enough information to make a decision and the ERA will proceed; or
- The information indicates a potential for adverse ecological effects, and a higher tiered BERA is required.

The following table presents a summary of recommended BERA areas of potential concern based on the final SLERA:

Exposure Area	Surface Soil	Groundwater	Sediment	Surface Water
Block A (former slag processing area)	O			
AOC 2 (closed landfill)	O			
AOC 21 (wooded area) and AOC 18 (on-site COG pipeline)	O			
AOC 7 (intermittent stream)	O		O	O
AOC 1 (sludge lay down area)	O	O		
AOC 19 (off-site COG pipeline)	O		O	O
Great Miami River			X [(b)]	O
Southern Parcel	O	X [(a)]		

X - Additional evaluation is warranted.
O - The potential for ecological risks is low to non-existent and no further evaluation is warranted.
(a) Additional evaluation of discharge to the river from AOC 13 perimeter wells was warranted.
(b) Additional ERA evaluation of the Great Miami River and riparian floodplain (AOC 22) was warranted.

2.1 Scientific Management Decision Point

It was concluded in the SLERA, and approved by OEPA and USEPA (OEPA, 2008b; USEPA, 2008), that the majority of the exposure areas at the Site fall into the first category (*i.e.*, sufficient information exists to conclude that the potential for ecological risk is low to non-existent) and no further evaluation is warranted. This finding is appropriate for the six terrestrial exposure areas evaluated (AOC 1, AOC 2, AOC 18 and AOC 21, AOC 19, Block A and Southern Parcel) as well as the AOC 7 dry bed intermittent stream. These areas did not indicate the potential for significant ecological exposure and/or risk when COPC concentrations in site media were evaluated against conservative screening levels in the SLERA. These areas provide little or no ecological habitat and future development of the areas would further decrease the potential for ecological exposure. These areas are not further evaluated in the BERA. The additional surface soil data that were collected in these AOCs in May 2008 were reviewed for potential anomalies as compared to data included in the SLERA and are presented in Appendix C. There were no new compounds or increases in concentrations that would warrant a re-evaluation of the potential ecological exposure in on-site terrestrial habitats. As a result, these areas are not further evaluated in the BERA.

The GMR Study area fell into the middle category and additional analysis in the next step of the ERA process (Problem Formulation and Refinement of COPC) was required in order to make informed risk-management decisions. None of the exposure areas evaluated in the SLERA fell into the latter category (*i.e.*, no data were evaluated which indicated a potential for adverse ecological effects). In addition, further investigation of the riparian floodplain (AOC 22) adjacent to the GMR was also recommended based on observations of tar-like material in the floodplain.

3.0 Refinement of COPC – Baseline ERA Field Study Design

During the study design phase, data quality objectives were developed, measurement endpoints were selected, and sampling and analysis plans were developed based on the potential for ecological risk identified as a result of the SLERA. The exposure pathway and receptor-specific investigations for the GMR have been conducted. The specifics regarding the OEPA/USEPA approved study can be found in the "Ecological Risk Assessment Supplemental Work Plan" (ENSR, 2007).

3.1 AOC 22- Riparian Floodplain

Eighteen surface soil samples were collected and analyzed in AOC 22 in May 2008 (Table 3-1). Chemical analysis included VOCs, SVOCs, PCBs, and inorganic compounds. This area of the site was not evaluated in the SLERA and as a result, the initial evaluation of data includes a comparison of the data to available ecological screening values (ESVs). In the event that an ESV is exceeded, the compound was considered a COPC and evaluated further.

To identify COPCs in the surficial soil data set, the maximum concentration of each constituent was compared to its respective soil risk-based benchmark. Soil screening values were selected to evaluate exposure to soil-associated receptors. No national criteria exist for screening of soil but several nationally recognized data sources were reviewed using the following hierarchy:

- If a U.S. EPA Ecological Soil Screening Value (Eco-SSL) was available, it was preferentially selected. The lower of the values for plants, invertebrates, mammals, and birds was selected. Values were obtained from http://www.epa.gov/ecotox/ecossl.
- ORNL (Efroymson et al., 1997a; 1997b) terrestrial plant and invertebrate screening values were selected when Eco-SSLs were unavailable. The more stringent or conservative of the terrestrial plant or invertebrate screening values were used to screen surface soils.
- If neither of the above screening values were available, then EPA Region 5 ESVs (USEPA, 2003a) were used.

Ecological screening benchmarks for sediment, and soil are presented in Table 3-2. The screening tables presented in the BERA include the following information: the frequency of detection, maximum detected value, location of the maximum detected value, and the results of the screening. Constituents were retained for further consideration as COPCs if the maximum detected concentration exceeded the screening benchmark, or if no screening benchmarks were available.

Compounds that are considered essential nutrients (*i.e.*, calcium, magnesium, potassium, and sodium) are considered ubiquitous in the environment, and were not retained for consideration as COPCs in any media at the Site.

The U.S. EPA surface soil screening values for aluminum and iron are not numerical values. The aluminum Eco-SSL document (U.S. EPA, 2003b) indicates that potential ecological risks associated with aluminum are identified based on the measured soil pH. Therefore, aluminum is only selected as a COPC if the soil pH is less than 5.5. At the request of OEPA and USEPA, field measurements of surface soil pH were taken in the fall of 2008 (Appendix D). An average pH result of 8.4 was determined after the evaluation of 5 locations on site. No individual pH measurement was at or below 5.5. Aluminum is not considered a COPC at the site.

The iron Eco-SSL document (U.S. EPA, 2003c) indicates that identifying a specific benchmark for iron in soils is difficult since iron's bioavailability to plants and resulting toxicity are dependent upon site-specific soil conditions (pH, Eh, soil-water conditions). Increases in soil pH or Eh (oxidizing conditions) shift iron from the exchangeable and organic forms to the water-insoluble and iron-oxide fractions. The document indicates that iron is not likely to be toxic to plants, in well-aerated soils between pH 5 and 8. Iron is not considered a COPC at the site.

In addition, the soil survey information for Butler County indicates that the Site is dominated by an Urban land-Eldean complex with areas of Eldean loam and Xenia silt loam along Jackson Road at the southwest portion of the property. Specific soil properties are not identified for Urban land, however the surficial soil pH range is expected to be from 5.6 to 7.3 for Eldean loam and from 6.6 to 7.3 for Xenia silt loam. These data indicate that the site-wide soil pH is likely to be within the range where aluminum and iron are not likely to be toxic. Therefore, these two compounds were not evaluated as potential COPCs in AOC 22 surface soil.

3.2 Great Miami River Sediment

Additional sediment data in the GMR was collected as part of the ERA Supplemental Work Plan implementation. Samples were located adjacent to the Site in order to further delineate the chemical stressor distribution in the sediment in the vicinity of the Site, and upstream of the Site to evaluate anthropogenic background conditions in the vicinity of the Site. Sediment samples were collected in conjunction with the biological sampling for macro invertebrates and finfish. A total of 15 sampling locations were selected based on a review of the historic data (i.e., sediment and groundwater samples evaluated in the SLERA). These data were used to further characterize the sediments adjacent to the Site, to assess the potential for groundwater discharge to the river from upland AOCs, and to address the observations of tar-like material in the floodplain. A sub-set of 13 surficial sediment samples were collected from 5 zones of the stream where fish biocriteria studies were conducted, and 11 discrete sampling locations were co-located spatially with macro invertebrate biocriteria sampling stations. These data are presented in Appendix A.

To identify COPCs in the sediment data set, the maximum concentration of each constituent was compared to its respective sediment quality risk-based benchmark. Literature-derived low-effect sediment quality benchmarks were selected to evaluate sediment-associated receptors exposure to constituents in sediment using the following hierarchy:

- If a consensus-based Threshold Effect Concentration (TEC; MacDonald, et al., 2000) was available for a constituent, this value was preferentially selected.
- If no TEC was available for a constituent, then low effect levels (LELs) from the Ontario Ministry of the Environment (OMOE) (Persaud et al., 1996) were selected.
- If neither a TEC nor an OMOE LEL was available, then effects range-low (ER-L) values from NOAA (Long and Morgan, 1990) were selected.
- If none of the above benchmarks were available, sediment screening values were either derived using U.S. EPA (1993) equilibrium partitioning theory and freshwater chronic toxicity values, or EPA Region 5 ESVs were used. Where appropriate, sediment screening values were adjusted to reflect the average total organic carbon (TOC) content of the receiving waterbody. Sediment screening levels were adjusted to either the average TOC of the AOC 7 sediments (2.0%) or the Great Miami River sediments (1.6%), as appropriate.
- If no screening values were identified in the previous sources, the NOAA Screening Quick Reference Tables (Buchman, 1999) and other sources such as EPA Region 4 freshwater sediment screening values or Region 3 freshwater sediment screening benchmarks were reviewed for relevant benchmarks or background concentrations.

3.3 Great Miami River Benthic Community

A fish, macroinvertebrate, and habitat assessment was conducted in the Great Miami River adjacent, upstream and downstream of the site during September and October 2007. US EPA, OEPA and AK Steel agreed that a study of the ecological conditions within the river was appropriate to determine what, if any, impacts the site is having on the ecological communities in the river. Sediment data alone did not support conclusion regarding the potential for site-related impacts to the GMR. The study was conducted according to OEPA methodologies (OEPA 1989a, 1989b, 2006a, 2006b, and 2006c) and procedures outlined in the USEPA and Ohio EPA approved "Ecological Risk Assessment Supplemental Work Plan for the Former Armco Hamilton Plant Site" (ENSR, 2007).

To assess the condition of the benthic macroinvertebrate community in the Great Miami River near the AK Steel Hamilton Site, 11 macroinvertebrate sampling locations were established from River Mile (RM) 37.7 to 40.3 (Figure 1-Appendix B):

GMRSD30 – The samplers were deployed along the right descending bank by wading from shore in deep glide habitat with slow current velocity and boulder to gravel substrate.

GMRSD29 – The samplers were set approximately mid-channel by wading in a broad riffle/run complex with swift current velocity and cobble to large gravel substrate.

GMRSD28 –The samplers were set approximately mid-channel by wading in deep run habitat with moderate to fast current velocity and unconsolidated gravel substrate. However, upon retrieval, the samplers were missing.

GMRSD27 – The samplers were deployed remotely by boat and set on the bottom at depths of approximately two to three meters in deep glide habitat with moderate current velocity. Like GMRSD28, the samplers were missing upon retrieval. However, based on the cut anchor lines, it appears that the samplers had been vandalized.

GMRSD26 – The samplers were deployed along the right descending bank by wading in glide habitat with very slow current velocity and cobble to gravel substrate. Upon retrieval, it was noted that both sets of samplers had moved downstream with one set on its side.

GMRSD25 – The samplers were set by wading from shore along the right descending bank of the river. This location consisted of glide habitat with slow current velocity and largely gravel substrate.

GMRSD24 – The samplers were deployed in run habitat along the right descending bank by wading. The current velocity was fast and the substrate consisted of largely cobble and large gravel.

GMRSD22 – The samplers were set by wading in run habitat along the right descending bank. The current velocity was fast and the substrate consisted of largely cobble.

GMRSD21 – The samplers were set by wading along the right descending bank in pool habitat with cobble, gravel, and silt substrate. Current velocity was nearly undetectable during both the set and retrieval. Upon retrieval, one set of samplers was missing and the other set had been moved from its original set location.

GMRSD20 – The samplers were deployed remotely by boat and set on the bottom at depths of approximately two meters in deep glide/pool habitat with slow current velocity. The samplers were set along the left descending bank where they were anchored to shore.

GMRSD23 – The samplers were deployed remotely by boat along the left descending bank and set on the bottom at depths of approximately two meters in pool habitat with slow current velocity. It appears flow in this area is at least periodically affected by the downstream low-head dam.

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the OEPA, the ICI is a modification of the Index of Biotic Integrity for fish (OEPA, 1988; DeShon, 1995). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by OEPA (1988). The sum of the individual metric scores resulted in the ICI score for that particular location.

In addition to the ICI, the benthic macroinvertebrate data were analyzed using OEPA's Qualitative Community Tolerance Values (QCTV). Unlike the more intensive ICI, which incorporates data from both an artificial substrate and qualitative sample at a given site, the QCTV uses information only from qualitative samples. The QCTV assesses the environmental tolerance or sensitivity of the macroinvertebrate community using tolerance values that are assigned to each taxon. OEPA derived these values by calculating the abundance-weighted average of all ICI scores from locations where a particular taxon was collected (DeShon, 1995). Taxa that are typically abundant at least disturbed sites have a lower tolerance value while those taxa that are generally abundant at highly disturbed sites have a higher tolerance value. As such, the range of tolerance values, 0="poor" to 60="excellent", is the same as the ICI scoring range. Only taxa that are represented by five or more observations in the OEPA database are used to determine the QCTV score at a given site. The QCTV score for a given site is expressed as the median of tolerance values for all taxa observed at the site that are also represented by five or more observations in OEPA's database (Mr. Jeffrey DeShon-OEPA, pers. comm.).

In addition to the ICI and QCTV, total taxa richness, Ephemeroptera+Plecoptera+Trichoptera (EPT) richness, and the number of tolerant (moderately tolerant and tolerant) and intolerant (moderately intolerant and intolerant) taxa were used to assist the evaluation of each site.

3.4 Great Miami River Fish Community

To assess the condition of the fish community and physical habitat in the GMR near the AK Steel Hamilton Site, five fish sampling zones were established from River Mile (RM) 37.7 to 40.3 (Figure 1-Appendix B):

GMRF30 – The start of this zone was located 0.75 mile downstream of a low-head dam and ended 250 m upstream of the AOC 7 ditch. The entire zone was located above the AK Steel Hamilton Site to document background conditions of the fish community. The zone consisted of deep and slow pool/glide habitat upstream with faster and shallower riffle/run habitat downstream. Sampling alternated between both right and left descending banks. For the purpose of determining attainment, the fish sampling zone included the benthic macroinvertebrate sampling locations GMRSD30, 29, and 28.

GMRF27 – Sampling began immediately downstream of the AOC 7 ditch and proceeded downstream for 500 m. The zone consisted entirely of slow and deep pool/glide habitat without a riffle. Sampling alternated between both right and left descending banks. The fish results for this zone were considered in conjunction with GMRSD27 benthos results for attainment purposes.

GMRF25 – This zone began downstream of AOC 13 and ended 30 m upstream of the AK Steel Hamilton Site intake structure. Habitat in the zone ranged from slow and relatively deep glide habitat upstream to shallow and fast riffle/run habitat downstream. Sampling was conducted primarily along the right descending bank. In order to determine attainment, results from GMRF25 were assessed collectively with the benthos results from sampling locations GMRSD26, 25, 24, and 22.

GMRF20R – The start of this sampling zone was located approximately 90 m downstream of the AK Steel Hamilton Site intake structure and ended approximately 75 m upstream of a railroad bridge and the Hwy. 127 bridge. The zone largely consisted of shallow and slow glide habitat without a riffle. In order to determine attainment, results from GMRF20R were assessed collectively with the fish results from GMRF20L and benthos results from sampling locations GMRSD21, 20, and 23.

GMRF20L – This sampling zone ran parallel on the opposite (left descending) bank as GMRF20R. This zone was added at the suggestion of Mr. Dave Altfater (OEPA – pers. comm.) because of relatively better habitat compared to GMRF20R. General habitat conditions on this side of the river were similarly slow but with more depth and cover. Benthic data from GMRSD21, 20, and 23 as well as fish results from GMRF20R were considered together with GMRF20L to determine attainment.

Fish sampling in each zone was conducted for 500 m using a 12' electrofishing boat according to standard OEPA guidance (OEPA, 1989a, 1989b). Collections were made on 6-7 September 2007 and 10-11 October 2007. A 5,000-watt generator and a Smith-Root type VI electrofisher were used to sample fish. All fish collected were identified, counted, batch weighed, and examined for Deformities, Erosion, Lesions, and Tumors; collectively known as DELT anomalies. In conjunction with the fish sampling, habitat was assessed at each location using the Qualitative Habitat Evaluation Index (QHEI).

4.0 Problem Formulation

In the SLERA (ENSR, 2008), preliminary COPCs were identified in the GMR. Table 4-1 presents a summary of the ecological COPCs for the GMR portion of the Site, as determined in the SLERA. These compounds were the focus of the sediment media sampling conducted in 2007. AOC 22 was identified (as a result of the SLERA) as an area of the site that warranted investigation considering its position and slope in between the site and the GMR. AOC 22 was not evaluated as part of the SLERA.

Table 4–1
Ecological COPCs – Sediment

Ecological COPCs in Great Miami River Sediment as Results of SLERA
Aluminum
Arsenic
Barium
Cadmium
Chromium (total)
Copper
Cyanide
Iron
Lead
Manganese
Mercury
Nickel
Vanadium
Zinc
Total PAHs
Total PCBs

Figure 2-1 presents the sediment sampling locations adjacent to the Site that were evaluated in the SLERA (ENSR, 2008) and the Draft Remedial Investigation Report (ENSR, 2006). Figure 2-2 and 2-3 presents the sediment and biological sampling locations that were evaluated in the Ecological Risk Assessment Supplemental Work Plan (ENSR, 2007). Figure 2-4 presents the soil sampling locations that were sampled in AOC 22 in May 2008.

OEPA sediment screening criteria were exceeded in surficial sediments at a number of historical sampling locations in the GMR. Concentrations of several inorganic compounds, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) in surficial sediment were elevated in some locations; as a result, the SLERA (ENSR, 2008) recommended additional sediment and biota sampling to better understand ambient conditions in the river as well as the potential for site-related impacts in the GMR. The focus of the supplemental sampling was on bulk sediment and biological data collection (*i.e.*, macro invertebrate and fish community assemblage surveys) to further evaluate the potential for risk of harm to ecological receptors due to exposure to COPCs in sediment. These data are presented in the Appendix A and B, respectively.

4.1 Selection of Specific Receptors and Exposure Pathways

It is not feasible to evaluate exposures and risks for each aquatic, avian and mammalian species potentially present within a study area. For this reason, specific, representative wildlife species are typically identified as receptors of concern (ROCs) for the purpose of estimation of quantitative exposures (doses) in a BERA. USEPA ERA guidance recommends selecting receptors that have a great likelihood of exposure and sensitivity to COPCs, ideally with home ranges that are of similar magnitude to the size of the site. Ideally, site-specific ecological data is collected to measure (versus estimate or model) the impact of residual impacts in site media. For this site, the BERA presents and evaluates sediment data in the GMR, benthic macro invertebrate and fish species community data specific to the GMR sediment sampling locations, and terrestrial ecological exposures via the comparison of detected compounds in surface soils of AOC 22 to site-specific background levels and ESVs. Figure 3-1 and Table 4-2 present a summary of the receptors and exposure pathways evaluated.

Table 4–2
Potential Exposure Pathways

Exposure Medium	Potential Receptors	Exposure Route	Pathway Evaluation
Great Miami River			
Sediments	Finfish	Direct Contact	Exposure of finfish to COPCs evaluated by comparisons to benchmarks, comparisons to upstream (background conditions), and fish community surveys conducted in accordance with OEPA biocriteria protocols
Sediments	Benthic Macro invertebrates	Direct Contact	Exposure of benthic macro invertebrates to COPCs evaluated by comparisons to benchmarks, comparisons to upstream (background conditions), and macro invertebrate community surveys conducted in accordance with OEPA biocriteria protocols
AOC 22 (Riparian Floodplain)			
Surface Soil	Terrestrial Invertebrates, Avian Species, Foraging Mammals	Direct Contact	Exposure of terrestrial invertebrates, birds and foraging mammals to COPCs evaluated by comparisons to benchmarks
Groundwater	Finfish and Benthic Macro invertebrates	Surface Water and Sediment Contact/Ingestion	Has been conducted quantitatively in the GMR. Data and results will be presented and qualitatively discussed.

It should also be noted that there are no known threatened and endangered species that have the potential to be present on the site (ODNR and USDOI, 2005).

4.2 Selection of Biological Endpoints to be Assessed

Risk assessment endpoints to be assessed at the Site include measurement and assessment endpoints. According to U.S. EPA (U.S. EPA, 1998), assessment endpoints are formal expressions of the actual environmental value to be protected. They usually describe potential adverse effects to long-term persistence, abundance, or production of populations of key species or key habitats. Measurement endpoints are the physical, chemical, or biological aspects of the ecological system that are measured to approximate or represent assessment endpoints.

Measurement endpoints are often stressor-specific and are used to evaluate the assessment endpoint with respect to potential ecological risks. Since each measurement endpoint has intrinsic and extrinsic strengths and limitations, several measurement endpoints will be used to evaluate each assessment endpoint. The measurement and assessment endpoints evaluated are presented in Table 4-3.

Table 4–3
Measurement and Assessment Endpoints

Assessment Endpoint ***Measurement Endpoint***
1. Sustainability of a healthy and well-balanced benthic invertebrate community in the Great Miami River in the vicinity of the Site which is typical of comparable upstream Great Miami River habitats with similar structure, morphology, and hydrology, and which is consistent with OEPA biocriteria expectations
a) Characterization of sediment metals bioavailability based on simultaneously extracted metals (SEM)/acid volatile sulfides (AVS) relationships. SEM/AVS ratios greater than 1 in a sediment sample was considered an indicator of potential bioavailability for divalent cationic metals. The influence of total organic carbon (TOC) was also considered.
b) Comparison of bulk sediment analytical chemistry results to sediment quality benchmarks. Site data in excess of sediment quality benchmarks will not necessarily be considered indicative of a potential for ecological risks as ecological risks resulting from sediment exposure has been biologically evaluated in the GMR. Biological data will determine the presence/absence of risk.
c) Field assessment of the benthic macro invertebrate community present in the GMR Study area. Various OEPA Biocriteria community composition, abundance, and diversity metrics were used to evaluate the potential risks associated with exposure to sediment in situ. Biological data will determine the presence/absence of risk.
d) Evaluation of near-Site sediments relative to upstream background conditions. The background evaluation was conducted in accordance with U.S. EPA (2002) guidance.
2. Sustainability of a healthy and well-balanced fish community in the Great Miami River in the vicinity of the Site which is typical of comparable upstream Great Miami River habitats with similar structure, morphology, and hydrology, and which is consistent with OEPA biocriteria expectations (a)
a) Comparison of bulk sediment analytical chemistry results to sediment quality benchmarks. Site data in excess of sediment quality benchmarks will not necessarily be considered indicative of a potential for ecological risks as ecological risks resulting from sediment exposure has been biologically evaluated in the GMR. Biological data will determine the presence/absence of risk.
b) Field assessment of the fish community present in the GMR Study area. Various OEPA Biocriteria community composition, abundance, and diversity metrics were used to evaluate the potential risks associated with exposure to sediment in situ. Biological data will determine the presence/absence of risk.
c) Evaluation of near-Site sediments relative to upstream background conditions. The background evaluation was conducted in accordance with U.S. EPA (2002) guidance.

4.3 Conceptual Site Model

The end product of the problem formulation step is the development of an ecological CSM. Figure 3-1 presents the CSM for the GMR adjacent to the Site and AOC 22. The ecological CSM is presented as a series of working hypotheses regarding how potential exposure to COPCs might pose a potential risk to the ecosystem and ecological receptors at the site. The CSM helps describe the origin, fate, transport, exposure pathways, and receptors of concern at the site. The SLERA (ENSR, 2008) focused on those pathways for which (1) chemical exposure are the highest and most likely to occur, and (2) there are adequate data pertaining to the receptors, exposure pathways, and ecotoxicity. The results of the SLERA indicated that the GMR warrants further investigation; therefore the CSM presented for the River in the SLERA has been refined for the BERA.

The previously described parameters, including fate and transport characteristics of COPCs, have been combined into a conceptual model that represents potential exposure pathways of COPCs from potential sources to relevant biological receptors. These pathways include a number of ingestion and direct contact pathways.

The primary exposure pathways for aquatic food chain receptors in the GMR include:

- Direct exposure to COPCs in sediment by benthic invertebrates and fish.

The primary exposure pathways for terrestrial/riparian food chain receptors identified in the AOC 22 evaluation include:

- Direct exposure to COPCs in floodplain surface soils via primary producers (e.g., plants), and potentially secondary, and tertiary consumers (e.g., terrestrial invertebrates, and avian and mammalian wildlife).

5.0 Risk Analysis

During the analysis phase, exposure to stressors and the relationship between stressor concentrations and ecological effects are evaluated. This phase involves collection and integration of information on COPCs, COPEC concentrations and spatial distribution, and exposure conditions (temporal and spatial patterns). Typically, exposure point concentrations (EPCs) of COPCs are determined and compared to toxicity reference values (TRVs) in order to calculate the potential for adverse effects.

Figure 2-2 and 2-3 depicts the sampling locations for the GMR Historical and Supplemental sampling program. Figure 2-4 depicts the surface soil sampling locations in AOC 22. These sampling locations were selected to represent the spatial and chemical concentration variability present at the Site. Sampling stations were selected based on a review of sediment data evaluated in the SLERA and a review of the potential for groundwater discharge to the river from upland AOCs, and were designed to address the recent observations of tar-like material in the floodplain of AOC 22. Sediment chemistry sampling (Appendix A) and macro invertebrate community assessment (Appendix B) were conducted at each sampling location and the fish community sampling zones encompassed most of the sampling locations.

The risk analysis phase of the BERA is based on the CSM developed in problem formulation. Risk analysis includes the characterization of potential ecological exposure and effects. The ecological exposure assessment involves the identification of potential exposure pathways and an evaluation of the magnitude of exposure of identified ecological receptors. The ecological effects assessment describes the potential adverse effects associated with the identified COPCs to ecological receptors and reflects the type of assessment endpoints selected. The approach that was used to identify and characterize ecological exposure and effects for aquatic and benthic life are described in the following subsections.

5.1 Selection of COPCs

COPCs for evaluation in the BERA were selected on a site-specific basis, as outlined above. Selection of these constituents included a variety of tools, including comparison of Site data to OEPA and USEPA screening values. Compounds detected in GMR sediments were evaluated in the SLERA (ENSR, 2008). Those compounds with a maximum concentration in excess of an ecotoxicological screening value were retained as COPCs in GMR sediment. Table 4-1 presents a summary of the GMR sediment COPCs that resulted from the SLERA. Additional sediment data and co-located biological data have been collected in support of further evaluation of the GMR. A background screening was conducted as part of the GMR sediment evaluation and included an evaluation of the sediment data from near-Site environments relative to upstream background conditions.

5.1.1 Ecological Screening in AOC 22 Surface Soils

AOC 22 was not evaluated as part of the SLERA for the site. As a result, the evaluation of AOC 22 surface soils includes a screening comparison to ESVs as well as an evaluation of background in the BERA.

Potential adverse ecological effects to terrestrial plants and invertebrates in AOC 22 were evaluated based on comparisons to literature-derived screening values. For the exposure pathways identified in Section 3.1, the highest measured constituent concentration in surface soil of AOC 22 was used to determine the potential for exposure to ecologically relevant concentrations of COPCs. In accordance with U.S. EPA Region 5 guidance, this conservative method was used to make sure that potential risks are being fully addressed because AOC 22 was not previously evaluated as part of the SLERA.

Constituents with maximum concentrations less than their respective literature-derived screening values were not retained as COPCs; constituents with maximum concentrations in excess of the literature-derived screening values were considered further. Constituents with no applicable screening value were retained as COPCs, as appropriate. Those COPCs lacking screening values were assessed for potential ecological risk, as feasible, and considered in the uncertainty analysis.

Table 5-1a summarizes the COPCs that resulted from this comparison. The statistical summary of the dataset is provided in Table 5-2 (in Tables Appendix).

Table 5–1a
Ecological COPCs – Surface Soil
Based Upon Comparison of Maximum Detections to ESVs

Ecological COPCs in AOC 22
Antimony
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Nickel
Selenium
Vanadium
Zinc
1-Methylnapthalene
Benzo(a)anthracene
Benzo(a)pyrene
Carbazole
Chrysene
Dibenzofuran
Fluoranthene
Napthalene
Phenanthrene
Pyrene
Methylacetate
Methylcyclohexane
Xylene
Total PAHs
Total PCBs

5.1.2 Background Screening in AOC 22 Surface Soils

The results of background soil sampling were used in a background evaluation to determine whether any of the identified (i.e., detected at concentrations above ESVs) COPCs in AOC 22 soil may be attributable to natural background, and not be site-related. Sections 2.10 and 4.28 of the RI Report (KEMRON, 2008) discuss the background soil sampling and analysis performed for the Site. In short, nine surface soil (0-2 feet bgs) samples and one duplicate and seven subsurface soil (3-4 feet bgs) samples were collected from off-site and unimpacted on-site locations and analyzed for TAL metals. The surface samples were also analyzed for dioxins/furans and PAHs. In addition, three slag composite samples (BGSLAG-1AA, -2AA, and-3AA) were collected in Block A (the former slag processing area) from a slag pile that appeared to be unimpacted from other operations and consisting entirely of historically processed slag. The background slag samples were analyzed for TAL metals.

The background comparison was conducted in accordance with the USEPA *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA, 2002), and as documented in responses to USEPA's comments on the draft HHRA. It was agreed that the approach to the evaluation of background in site soils for both the HHRA and BERA would follow USEPA guidance. For the three soil areas with new soil data (AOC 13, Southern Parcel, and AOC 22), as agreed upon with USEPA, the latest version of ProUCL (Version 4.00.02) was used to perform the background evaluation. Appendix F describes the methods and results in detail, including an addendum that summarizes the updated evaluations. Surface soil data for a limited suite of inorganics and potentially carcinogenic PAH were included in this background evaluation.

Based on the results of the background evaluation, concentrations of several COPCs in on-site surface soil were found to be consistent with background surface soil concentrations. The potential risks presented for these COPCs are therefore likely to be related to background and not the Site. Notable among the chemicals identified as consistent with background surface soil are arsenic, lead and potentially carcinogenic PAH in all AOCs, as well as mercury and iron in several AOCs. These results should be considered in the evaluation of potential risks due to surface soil. The CERCLA program does not require clean up to concentrations below natural or anthropogenic background levels (USEPA, 2002).

Surface Soil COPCs Consistent with Background

AOC 1	Arsenic
	Mercury
	Carcinogenic PAHs
AOC 2	Arsenic
	Iron
	Mercury
	Carcinogenic PAHs
AOC 13	Arsenic
	Iron
	Lead
	Vanadium
	Carcinogenic PAHs
AOC 18 and 21	Arsenic
	Iron
	Mercury
	Carcinogenic PAHs
AOC 19	Arsenic
	Iron
	Manganese
	Mercury
	Carcinogenic PAHs
AOC 22	Aluminum
	Arsenic
	Iron
	Lead
	Mercury
	Vanadium
	Carcinogenic PAHs
Block A	Arsenic
	Mercury
	Carcinogenic PAHs
Southern Parcel (excluding AOC 13)	Arsenic
	Lead
	Carcinogenic PAHs

Compounds shown to be consistent with background in AOC 22 surface soils were screened from the list of COPCs as follows:

Table 5–2a
Ecological COPCs – Surface Soil
COPCs Eliminated Based Upon Consideration of Background

Ecological COPCs in AOC 22
Antimony
Cadmium
Chromium
Copper
~~Lead~~
Manganese
~~Mercury~~
Nickel
Selenium
~~Vanadium~~
Zinc
1-Methylnapthalene
~~Benzo(a)anthracene~~
~~Benzo(a)pyrene~~
Carbazole
~~Chrysene~~
Dibenzofuran
Fluoranthene
Napthalene
Phenanthrene
Pyrene
Methylacetate
Methylcyclohexane
Xylene
Total PAHs
Total PCBs

95% Upper Confidence Limits (UCL) of the population arithmetic mean were developed for the remaining COPCs using USEPA Pro UCL 4.0 software for each constituent. 95%UCLs for COPCs with low detection frequencies were compared to ESVs (Table 5-2 in Tables Appendix). Mercury, Nickel, Selenium, Fluoranthene and Pyrene were eliminated as COPCs as a result of this comparison. Similarly, 3 VOCs (methylacetate, methylcyclohexane, and Xylene) were eliminated as COPCs as a result of low detection frequencies and the fact that they were not significant COPCs in on-site media. As a result, the COPC list includes:

Table 5–2b
Ecological COPCs – Surface Soil
Based Upon Comparison of 95%UCLs to ESVs

Ecological COPCs in AOC 22
Antimony
Cadmium
Chromium
Copper
Manganese
Zinc
1-Methylnapthalene*
Carbazole*
Chrysene
Dibenzofuran*
Napthalene
Phenanthrene
Total PAHs
Total PCBs**

* - No ESV for this compound.
** - Compound did not exceed ESV

5.2 Great Miami River Sediment Sampling

Sediment sampling and analysis activities were conducted in 2005 as part of the initial remedial investigation sampling program. Surficial sediment samples (0 to 15 cm stratum) were collected from several different areas evaluated in the SLERA: the Great Miami River along the Site boundary, the Great Miami River in the vicinity of AOC 19, AOC 7 (the dry bed intermittent stream channel), and at two upstream background locations. Analytes evaluated in the SLERA included inorganic constituents, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs).

The SLERA (ENSR, 2008) indicated that no additional ecological evaluation was warranted in the Great Miami River in the vicinity of AOC 19 (where the coke oven gas pipeline formerly crossed under the river) or within AOC 7 (an intermittent stream located adjacent to the closed landfill (AOC 2)). The SLERA concluded that elevated levels of some COPCs (i.e., metals, PAHs and PCBs) may be present in the sediments located adjacent to the Site and that additional investigations were warranted. The SLERA also recommended that AOC 7 be viewed as a conveyance to the river and considered as a secondary source area in the evaluation of the Great Miami River and that additional river sampling and analysis be conducted in the vicinity of the AOC 7 discharge to the Great Miami River.

As a result, additional sediment sampling and analysis activities were conducted in September 2007 and designed to obtain a comprehensive set of physical, chemical, and biological data for the Great Miami River adjacent to the Site. Samples were located adjacent to the Site in order to further delineate the chemical stressor distribution in the sediment in the vicinity of the Site and upstream of the Site to evaluate anthropogenic background conditions in the vicinity of the Site. Sediment samples were collected in conjunction with the biological sampling for macroinvertebrates and finfish. A total of 15 sampling locations were selected based on a review of the historic data (i.e., sediment and groundwater samples evaluated in the SLERA). These data were used to further characterize the sediments adjacent to the Site, to assess the potential for groundwater discharge to the river from upland AOCs, and to address the recent observations of tar-like material in the floodplain. A sub-set of 13 surficial sediment samples were collected from 5 zones of the stream where fish biocriteria studies were conducted, and 11 discrete sampling locations were co-located spatially with macroinvertebrate biocriteria sampling stations.

The sampling station locations were selected following a "Targeted Sampling Design" (USEPA, 2001b) where prior knowledge of site-related factors are incorporated into the process of selected station locations. The targeted sampling design was selected to minimize sampling error attributable to selecting sampling stations that may not represent the defined area of interest or stations with similar physical characteristics as described in the study data quality objectives (DQO) process (U.S. EPA, 2001b). Sampling station locations were targeted to represent "worst case" conditions by selecting sampling locations in the vicinity of known outfalls (i.e., AOC 7), observations of tar-like material, and previously elevated COPC concentrations.

The targeted sampling horizon was the upper 0 to 15 cm of sediment. Generally, this is the sediment horizon of interest as it contains the most recently deposited sediments, and the most epifaunal and infaunal organisms are found within this horizon (U.S. EPA, 2001b). However, due to the presence of cobble and large rocks, the sampling horizon achieved ranged from 1 to 10 cm with an average of 4 cm.

Figure 2-3 present the locations of the sediment samples considered in this evaluation. Samples from 2005 and 2007 sampling events were segregated into the following three groupings based on proximity to the Site:

- The **Upstream** data set includes 7 surficial samples located upstream of the influence of the Site (i.e., this data set serves as the Reference Conditions data set). It is assumed that the data from this reach of the river are uninfluenced by Site conditions.
- The **Adjacent** data set includes 19 surficial samples located immediately adjacent to the Site. These samples were collected to represent potential impacts associated with historic Site activities.
- The **Downstream** data set includes a single surficial sample located downstream of the Site in a portion of the river containing habitat that is consistent with conditions found adjacent to the Site.

Sediment samples were analyzed for metals, PCBs, PAHs, TOC, simultaneously extracted metals (SEM), and acid volatile sulfides (AVS). Methodologies for sample collection, processing, and analysis were consistent with those presented in the Remedial Investigation/Feasibility Study Support Sampling Plan for the Former ARMCO Hamilton Plant Site (ENSR, 2005) and in the OEPA Sediment Sampling Guide and Methodologies (OEPA, 2001a).

Total organic carbon (TOC) levels in sediments from the Great Miami River ranged from 0.17% adjacent to the Site (GMRSD24) to a maximum of 4.3% just upstream of the Site (GMRSD28) (Figure 5-2). As expected, observations of low TOC were generally found in samples with more coarse grained material and higher TOC levels were associated with observations of finer grained silty sediments.

Potential adverse ecological effects to benthic invertebrates were evaluated based on comparisons to literature-derived screening values and Ohio-specific Sediment Reference Values (SRVs), as well as through an evaluation of the potential bioavailability of divalent metals through the SEM and AVS data evaluation.

5.2.1 Great Miami River Fish and Benthos Sampling

Fish and benthic macroinvertebrate community assessment was conducted in the fall of 2007 (Appendix B). Fish sampling was conducted for 500 m using a 12' electrofishing boat according to standard OEPA guidance (OEPA 1989). Collections were made on 6-7 September 2007 and 10-11 October. A 5,000-watt generator and a Smith-Root type VI electrofisher were used to sample fish. All fish collected were identified, counted, batch weighed, and examined for Deformities, Erosion, Lesions, and Tumors; collectively known as DELT anomalies. In conjunction with the fish sampling, habitat was assessed at each location using the Qualitative Habitat Evaluation Index (QHEI).

Macroinvertebrates were surveyed quantitatively and qualitatively at each of the three stations using OEPA methodologies (OEPA 1989 and 2006c). Quantitative collections were made with modified Hester-Dendy artificial substrate samplers (HD). HDs were set on 14-15 August and retrieved on 25-26 September. Qualitative samples were collected by kick netting and handpicking during HD retrieval.

Assessment of biological community health was based primarily on Ohio EPA index scores (i.e., IBI, IWBmod, and ICI scores). Comparisons were made both among sampling stations and against warmwater habitat (WWH) numeric biocriteria for the Eastern Corn Belt Plains (ECBP) ecoregion: IBI=42, IWBmod=8.5, and ICI=36. To account for biological variability, Ohio EPA considers IBI or ICI scores within 4 units of the biocriterion to meet the criterion (this is referred to as Insignificant Departure). Similarly, OEPA allows for a 0.5 unit Insignificant Departure for IWBmod scores. Standard OEPA guidance was utilized in determining attainment versus non-attainment of each applicable biocriterion.

5.2.1.1 Fish

The two sampling passes at the five locations yielded 5,328 fish representing 33 species and *Lepomis* hybrid (Table 1). Five intolerant species were collected: rosyface shiner, mimic shiner, black redhorse, stonecat, and banded darter. Numerically, the catch was dominated by bluntnose minnow (24 percent), spotfin shiner (16 percent), golden redhorse (10 percent), logperch and suckermouth minnow (9 percent each). No threatened or endangered species were collected during this study.

Mean IWBmod scores ranged from 8.0 to 9.7 and indicated a marginally good to exceptional fish community in this portion of the Great Miami River, based on OEPA narrative ranges (OEPA 1988 and 2006b). Mean IWBmod scores were highest at the upstream reference site, lowest immediately downstream at GMRF27, and intermediate at the lower three locations. IWBmod scores were generally similar in September and October, except at GMRF25, which exhibited a higher score in October than September.

Differences in species richness, CPEs, and community indices appear to be related to habitat quality. As discussed in Section 3.3 of Appendix B, habitat quality likely affected the distribution of fishes, particularly at the furthest upstream two sites. For example, GMRF27 clearly contained the poorest habitat quality based on QHEI scores and this zone had the lowest mean IBI, IWBmod, and catch rates among all zones. GMRF27 contains very poor substrate quality and lacks riffle/run habitat. Consistent with the poor substrate quality and lack of riffle/run habitat was the lower abundance of species preferring such habitats (e.g., darters, round body suckers, and suckermouth minnow). Conversely, GMRF30 had the best habitat, particularly regarding substrate quality, channel morphology, and riffle/run quality and this location had the highest mean catch rate, species richness, and IWBmod value of all zones. Collectively, these data suggest that habitat quality was a primary contributing factor to the variability in species composition, catch rates, and community indices observed throughout the study area.

In Ohio, attainment of the benthic community can only be determined by calculating the ICI. However, for the Qualitative Community Tolerance Value (QCTV), OEPA has calculated the upper 25th percentile and lower 75th percentile of the scores for each ecoregion representing Excellent to Good sites and Fair to Poor sites, respectively. For the Eastern Corn Belt Plain (ECBP) Ecoregion, the QCTV percentile thresholds are:

Percentile	ECBP QCTV Thresholds
25th – Excellent-Good	38.70
75th – Fair-Poor	34.8

A QCTV score that exceeds the 25th percentile suggests that the site is in attainment of its WWH designated use while a QCTV score less than the 75th percentile suggests that the site is not attaining its designated use. Sites with QCTV scores that fall near these thresholds were evaluated using additional parameters to assist in determining whether the site was in attainment. QCTV scores that clearly fall between the two thresholds were considered undetermined. An area of insignificant departure has not been defined by OEPA for the QCTV as they have for other indices.

5.2.1.2 Benthic Invertebrates

HD samplers were deployed at 11 locations throughout the study area. Samplers were successfully retrieved from nine of the 11 locations. Among the 11 locations and sampling types combined, 101 macroinvertebrate taxa were collected during the 2007 survey (Table 6-Appendix B). Chironomidae was the most taxa rich group among the locations with 23 taxa followed by Ephemeroptera (17 taxa), Trichoptera (12 taxa), and Coleoptera (10 taxa). Overall, total taxa richness among the HD samples ranged from 27 taxa at GMRSD21 and 23 to 21 taxa at GMRSD26 (Table 7-Appendix B). Qualitative total richness among the 11 locations ranged from 50 taxa at GMRSD30 to 26 taxa at GMRSD28 (Table 8-Appendix B).

ICI scores were calculated for nine of the 11 macroinvertebrate locations with both HD and qualitative sample results. Due to the loss of HD samples at GMRSD28 and 27, the median QCTV was determined to evaluate the benthic community. As with EPT richness, ICI scores at most locations were similar (Table 9-AppendixB). Among the nine locations, ICI scores ranged from 50 at GMRSD29 to 24 at GMRSD21. Of the nine locations, six clearly attained the WWH ICI biocriterion of 36 with scores in the "very good" to "excellent" narrative range (OEPA 2006b). A seventh location downstream of the AK Steel Hamilton Site, GMRSD23, achieved the biocriterion via Insignificant Departure (OEPA, 1988). In contrast, ICI scores from GMRSD26 and 21 rated "fair" and did not attain the established biocriterion. Among the ten ICI metrics, both locations exhibited similarly poor results for three of the metrics: Number of Mayfly Taxa, Number of Caddisfly Taxa, and Percent Other. Although the data from locations GMRSD26 and 21 may suggest impairment, it is important to note that the samplers at both locations had been disturbed during the colonization period. Furthermore, current velocity at the two stations was among the lowest measured in the study area. As such, it appears that multiple factors may have contributed to the lower ICI scores at these locations.

ICI scores were not calculated for GMRSD28 and 27. However, the median QCTV for each location was greater than the 25th percentile of "good" to "excellent" ICI sites (Table 9-Appendix B). In addition, there were twice as many intolerant taxa compared to tolerant taxa at GMRSD28 and 27; nine versus four and twelve versus six, respectively (Tables 6 and 8-Appendix B). These results strongly suggest that the ICI biocriterion for the ECBP ecoregion was being achieved (DeShon, 1995).

In general, the benthic macroinvertebrate community in the study area met or exceeded the ecoregional reference condition as defined by the ICI. The poorer quality benthic communities observed at GMRSD26 and 21 appear to be attributable, at least in part, to habitat constraints associated with velocity. The moderately tolerant midge, *Glyptotendipes* was the most abundant taxon at both locations. However, *Glyptotendipes* is not necessarily tolerant of toxic stressors, but is considered tolerant of organic/nutrient loading and associated dissolved oxygen impacts (Yoder and Rankin, 1995; Yoder and DeShon, 2003). Furthermore, *Glyptotendipes* is often associated with slow current habitats (Epler, 2001). Pollution sensitive EPT taxa generally prefer areas with good exchange associated with flow and clean substrate. As indicated previously, GMRSD26 and 21 are in largely pool/glide areas with slow current velocity and finer substrate. Given these conditions and the fact that current velocity is vital to the collection of consistently good HD results (OEPA, 1988), it is not surprising that the scores from these locations did not attain the ICI biocriterion.

5.2.2 Habitat

Habitat was evaluated using OEPA's QHEI (Qualitative Habitat Evaluation Index) (OEPA 2006a; Rankin 1989, 1995) at five locations in 2007. Methods for calculating the QHEI are described in OEPA's User Manual (OEPA 2006a) and therefore are not discussed in detail here. Principal components (metrics) that are used to develop the QHEI score are:

- substrate
- cover
- channel morphology
- riparian zone and bank erosion
- pool, riffle, run quality
- stream gradient

QHEI scores from hundreds of stream segments around the State of Ohio have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas, whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the Warmwater Habitat (WWH) biological criteria (Rankin, 1995). Support or non-support is independent of water quality, i.e., even if water quality is compliant with applicable standards, a stream with QHEIs <45 usually will not support warmwater aquatic communities.

Overall, the habitat quality was fair to excellent at the five locations sampled in 2007. Habitat quality was best at the furthest upstream location GMRF30 (QHEI score 83.0), worst at GMRF27 (54.0), and intermediate at the furthest three downstream locations (QHEI range 62.5 to 72.5). Nearly all metric scores were higher at GMRF30 than at the other four locations, especially for substrate and riffle/run metrics (Table 10-Appendix B). In particular, GMRF30 contained more, larger and hard substrate (i.e., boulder and cobble) with less silt. In addition, GMRF30 and 25 were the only sampling zones with at least one well defined riffle/run complex. As a result, species that require clean, hard, substrates with well developed riffles and runs (most darter species and suckermouth minnow) were more abundant at GMRF30 and GMRF25 than elsewhere. In contrast, substrate quality at GMRF27 was very poor and was dominated by silt and artificial substrate types, which contributed greatly to the lower QHEI score there (Table 10- Appendix B). Other metrics which contributed to the comparatively poor QHEI score at GMRF27 include channel, riparian, and riffle/run quality. Overall, the two furthest downstream zones, GMRF20L and GMRF20R, contained similar habitat quality. However, instream cover was decidedly better at GMRF20L (Table 10-Appendix B). In fact, the cover score at GMRF20L was higher than any other zone and likely contributed substantially to the better index scores there. As such, species that prefer an abundance of instream cover (e.g., centrarchids) were substantially more abundant there than elsewhere.

5.2.3 Water Quality

Basic water quality parameters were collected during each fish sampling event. Concurrent with collections in each sampling zone, water temperature, dissolved oxygen, and specific conductance were measured. In addition, water clarity (Secchi disc reading) was measured at each station in conjunction with the fish sampling.

Water temperatures ranged from 17.9 to 27.1 C (Table 11-Appendix B). Temporal changes in water temperature conformed to expected patterns; on average, water temperatures were 5.3 C cooler in October than in September 2007. Spatially, water temperatures were generally warmer (2.0 to 4.0 C) upstream than downstream (Table 11-Appendix B). These temperature differences were likely due to diel effects rather than a real longitudinal temperature change. For example, the upstream reference location was consistently sampled during early-mid afternoon (1205-1444 hours), whereas the furthest downstream locations were sampled during mid-morning (0918 and 1015 hours). Nonetheless, water temperatures at all stations were within ranges easily tolerated by warmwater fishes.

DO values ranged from 6.6 to 14.1 mg/l during the 2007 study (Table 11, Appendix B). On average, DO values were higher in September (11.9 mg/l) than in October (9.8 mg/l). DO values were consistently higher at the upper three sites (range 10.5 to 14.1 mg/l) compared to the lower two sites (6.6 to 8.9 mg/l). These differences were most pronounced between GMRF25 and the lower two locations (i.e., GMRF20R and GMRF20L) where DO values declined by 11.5 mg/l (September) and 4.7 (October). All DO concentrations met the minimum WWH criterion of 4 ppm during each sampling event.

Specific conductance values and Secchi readings varied little spatially and temporally and ranged from 896 to 962 µScm and from 43 to 66 cm, respectively (Table 11, Appendix B).

5.3 Persistent, Bioaccumulative and Toxic Compounds

Persistent, bioaccumulative and toxic (PBT) compounds include any compound that may be reasonably anticipated to bioaccumulate in animal tissues (OEPA, 2008a). Chemicals with Log Kow values greater than or equal to 3.0 which are not metabolized or are metabolized slowly by ecological receptors are considered to bioaccumulate in animal tissue. A PBT compound is typically not screened from soil or sediment unless the method used to derive the screening value considered exposure to higher trophic level organisms in the development of the value.

The only PBTs in AOC 22 soils and GMR sediment above background are mercury and PCBs. PCBs have been detected to a limited extent in site soils, a greater extent in GMR sediments and below ESVs in AOC 22 (riparian floodplain) surface soils. On-site mercury and PCB levels were not determined to be a potentially significant ecological risk as a result of exposure to terrestrial on-site surface soils in the SLERA (ENSR, 2008). PCBs in the upstream GMR sediments have been shown to exist at levels above and consistent with that measured in the River sediment adjacent to the site (Table 1- Appendix A). Upstream sources of mercury and PCBs in GMR sediment have the potential to redistribute and deposit along the floodplain during storm events. The PCB concentrations measured in AOC 22 surface soils did not exceed the site ESV for PCBs and the sample locations for mercury and PCBs were along the floodplain that is frequently influenced by rises in water levels of the River. Floodplains are a known deposition area for sediments that are disturbed and redistributed during a storm event.

Furthermore, multimetric biological indices (i.e., Index of Biotic Integrity (IBI), modified Index of Well-Being (MIwb), and the Invertebrate Community Index (ICI)) did not indicate reduced or impacted abundance or diversity relative to the presence of PBT compounds in GMR sediment (Appendix B). Considering that the on-site soils do not present a mercury or PCB ecological risk and population level reproductive effects were not observed in the biological community assessment of the GMR (Appendix B), below ESV levels of PCBs in AOC 22 (floodplain) soils and infrequent detections of mercury are not considered site-related and will not be further evaluated as part of this BERA.

In addition, the ecological habitat provided in AOC 22 is not of high ecological quality or significance. AOC 22 consists of a significant slope that runs between the site and the GMR floodplain that, by definition, is in a constant state of change. The AOC 22 slope habitat does have some tree and shrub cover, however, as a result of the slope, there are more desirable habitat areas nearby. Construction debris exists along much of the slope of AOC 22 which further limits the desirability of habitat for ecological receptors. The potential for significant ecological exposure in AOC 22 soils is limited.

Based upon the ecological data collected, PBTs are not considered a significant threat in the GMR as a result of site activities or releases to the River. A food-web analysis of PBTs is not considered warranted based upon: 1) the presence of upstream sources of PBTs as identified in upstream sediment samples, 2) a limited presence of PBTs in sediment samples adjacent to the site or potentially site-related, 3) the limited presence of PBTs in site soils adjacent to or near the River, and 4) the integrity of the benthic biological community in the GMR (Appendix B).

No further assessment of sediment or riparian soil data in or near the GMR is anticipated as a result of the conclusion of "no effect" that resulted from the quantitative evaluation of sediment dwelling organisms (macro invertebrates) and fish in the GMR (KEMRON and EA Engineering, 2007). OEPA review of the Work Plan for this effort resulted in approval for AK Steel to "consider a "no effects" survey result as an off-ramp to further investigation of the Great Miami River for this site" (OEPA, 2007c).

6.0 Risk Characterization

The results of the environmental risk analysis were analyzed and interpreted to determine the likelihood of adverse environmental effects, and to determine whether a conclusion of no significant risk can be reached for each assessment endpoint evaluated. Risks will be estimated in the BERA through an integration of exposure and stressor-response profiles, and risks will be described by discussing lines of evidence and determining ecological impact. The conclusions regarding overall risk(s) to ecological receptors were based on a weight-of-evidence approach, which considers the results of all components of the assessment methodology (*i.e.*, an approach that integrates results of physical, biological, toxicological, and field measurement endpoints to draw risk-based conclusions). Individual measurement endpoint results were evaluated to determine whether or not they support a finding of no significant risk for each assessment endpoint. The documentation of the risk characterization will include a summary of the strengths and weaknesses of the analysis phase of work, and justification of conclusions regarding the ecological significance of the estimated (*i.e.*, risk of harm) or actual (*i.e.*, evidence of harm) risks.

6.1 Great Miami River Sediment

Based on the results of the SLERA, the sediment COPCs to be evaluated in the BERA included selected metals, PAHs and PCBs. Tables of the analytical data for GMR sediment are presented in Appendix A. If a chemical was detected at least once in any of the sediment samples it was evaluated further. Estimated concentrations (J-coded values), including those below the quantitation limit but above the Method Detection Limit (MDL), were treated as detected values.

PAHs and PCBs were evaluated as Total PAHs and Total PCBs, respectively. These totals were calculated using two different methods in order to bracket the high and low estimates of the totals. In the low-end estimate only the detected individual PAH or PCB constituents in a single sample were included in the sum total for that sample (i.e., non-detects were treated as zeroes, and this value represents total detected PAHs or PCBs). In the high-end estimate, if an individual PAH or PCB was detected at least once during the 2005 or 2007 sampling, the chemical's detection limit was used as a proxy concentration in the estimation of the sum total for those instances in which the chemical was reported as undetected (i.e., full detection limit was used as surrogate for non-detects). Both the high and the low totals were included in the sediment evaluation. These values bracket the total estimated PAH and PCB concentrations presented in the SLERA which used ½ of the detection limit as a surrogate for non-detects. The sum total data were updated in accordance with recent U.S. EPA guidance (U.S. EPA, 2007), which strongly discourages the use of ½ of the detection limit as a surrogate for non-detects in the calculation of upper confidence limits. To be consistent with that recommendation, ½ of the detection limit is not being used as a default surrogate for non-detects in the calculation of constituent totals in this evaluation.

The following is the list of the individual PAHs detected at least once: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

The following is the list of individual PCB Aroclors detected at least once: Aroclor 1242, Aroclor 1248, Aroclor 1254, and Aroclor 1260. Because of the high degree of overlap among these Aroclor mixtures, the process of summing of the Aroclors to obtain total PCB concentrations is likely to over-estimate the actual total PCB concentration present in river sediment.

6.1.1 Comparison to Ecological Screening Values

Potential adverse ecological effects to benthic invertebrates and aquatic receptors were evaluated based on comparisons of concentrations of constituents in sediment to literature-derived screening values. Exceedances of the ecological screening values may indicate the need for further evaluation of the potential ecological risks posed by the Site, but does not necessarily imply an ecological risk. For instance, certain COPCs may not be bioavailable, may not be absorbed into an organism's system following ingestion, or may not be absorbed through direct contact due to the chemical form of the COPCs. The decision concerning the necessity for further evaluation requires the weighing of such factors as the frequency, magnitude, and pattern of these exceedances relative to the background and anthropogenic conditions upstream of the site.

To identify COPCs, concentrations of each compound were compared against their respective low effect and probable effect based sediment screening values in a sample-by-sample evaluation (Table 6-1). Sediment quality benchmarks were selected to evaluate sediment-associated receptors exposure to constituents in sediment using the following hierarchy:

- Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) (MacDonald, et al., 2000).
- Low Effect Levels (LELs) and Severe Effect Levels (SELs) from the Ontario Ministry of the Environment (OMOE) (Persaud et al., 1993).
- Effects Range-Low (ER-L) and Effects Range-Medium (ER-M) values (Long and Morgan, 1990).

If none of the above benchmarks were available, other sources such as U.S. EPA Region 5 Ecological Screening Levels (U.S. EPA, 2003), National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (Buchman, 1999), U.S. EPA Region 4 freshwater sediment screening values or Region 3 freshwater sediment screening benchmarks were reviewed for relevant benchmarks or background concentrations.

Table 6-1 presents the sample-by-sample comparison of the sediment analytical data to the relevant ecological screening values. Four compounds (calcium, magnesium, potassium, and sodium) are considered to be essential nutrients, are ubiquitous in the environment, and were therefore not retained compared against ecological screening values. Two metals, antimony and silver were analyzed for but never detected so they were also excluded from the comparison against ecological screening values. Low effect screening values were not identified for beryllium and thallium and probable effect screening values were not identified for aluminum, barium, beryllium, cobalt, cyanide, selenium, thallium, and vanadium.

Aluminum, cobalt, and vanadium were below the low effect screening values in all sediment samples indicating that potential risks to benthic receptors due to these constituents are unlikely.

6.1.1.1 Upstream Data

Within the Upstream data set of seven samples, low effect screening values for arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc were exceeded in at least one sample. The probable effect screening values for chromium, copper, iron, lead, nickel, zinc were exceeded in the most upstream station (GMRSD19) and the probable effect screening values for Total PAHs and Total PCBs were exceeded in GMRSD28 when the upper estimate of the totals was evaluated (i.e., full detection limit used as surrogate for non-detects).

6.1.1.2 Adjacent Data

Within the Adjacent dataset of 19 samples (plus two duplicate samples), low effect screening values were exceeded for the same 12 constituents as in the Upstream dataset. In addition, a single detection of cyanide at station GMRSD1 also exceeded the low effect screening value. This station is located at the most southern end of the Site. The probable effect screening values for copper, lead, manganese, zinc, Total PAHs and Total PCBs were exceeded within the Adjacent dataset.

Both the low-end and high-end Total PAH and Total PCB concentrations in the Adjacent dataset exceeded the probable effect screening values; however, these exceedances were limited to a small area represented by GMRSD6 and GMRSD31. Samples collected just upstream and just downstream of this location had much lower PAH and PCB concentrations that were below the probable effect value.

There are three constituents (chromium, iron, nickel) that exceeded probable effect screening values in the Upstream data set, specifically in GMRSD19, but not in the Adjacent dataset. Manganese and the low-end Total PAH and Total PCB estimates exceeded the effect-based screening values in the Adjacent dataset but not in the Upstream dataset. The exceedances for manganese and the low-end Total PCB estimate were limited to single samples, GMRSD32 and GMRSD6, respectively. The exceedances for low-end Total PAH estimate were limited to GMRSD6 and GMRSD31.

Five inorganic constituents (barium, copper, iron, manganese, and nickel) detected in samples collected in the vicinity of the AOC 7 discharge to the Great Miami River (GMRSD14 and GMRSD27) exceeded the low effect screening value. Total PAH and Total PCB concentrations also exceeded the low effect, but not the probable effect, screening values. Concentrations of all of these constituents were within the range of concentrations observed in the Upstream dataset indicating that it does not appear that AOC 7 is discharging significant levels of metals, PAHs, or PCBs.

Seven inorganic constituents (barium, copper, iron, lead, manganese, nickel, and selenium) detected in samples collected in the vicinity of AOC 13 (GMRSD26, GMRSD4, and GMRSD7) exceeded the low effect screening value and the lead concentration at GMRSD26 also exceeded the probable effect screening value. Total PAH and Total PCB concentrations also exceeded the low effect, but not the probable effect, screening values. With the exception of lead and selenium, the concentrations of these constituents were within the range of concentrations observed in the Upstream dataset indicating that it does not appear that groundwater discharging from AOC 13 is contributing significant levels of metals, PAHs, or PCBs. The selenium concentration in GMRSD26 (2.8 mg/kg) is slightly above the maximum observed in the Upstream dataset (2.3 mg/kg) and the low effect screening level (2.0 mg/kg). The lead concentration in GMRSD26 (2980 mg/kg) is higher than levels detected Upstream or at any other Adjacent location. Lead concentrations in downstream samples (i.e., GMRSD4, GMRSD7, and GMRSD3 sampled in 2005 and GMRSD25 sampled in 2007) were orders of magnitude lower than in the GMRSD26 sample, indicating that only a discreet area is impacted by this lead level.

During the SLERA evaluation of the 2005 data, elevated levels of Total PAHs and Total PCBs were detected at station GMRSD6. Therefore, additional sampling was conducted in 2007 in an attempt to further delineate these COPCs at that location. Station GMRSD31 is essentially co-located with GMRSD6 and this 2007 sample, and its duplicate, contain levels of Total PAHs above the probable effect screening values and Total PCB concentrations above the low effect screening levels. However, the PAH and PCB levels observed at this location in 2007 were much lower than in 2005. In addition, the PAH and PCB concentrations in nearby samples (GMRSD32 and GMRSD24) are much lower than in GMRSD31 and well below the probable effect screening levels. These results indicate that elevated concentrations of PAHs and PCBs are in a relatively small area and, given the concentration change between 2005 and 2007, concentrations may be decreasing or the presence of these constituents may be very heterogeneous.

Stations GMRSD22, GMRSD2, GMRSD21, GMRSD5, GMRSD20, GMRSD1, and GMRSD8 are all located in the vicinity of tar-like material observed within the adjacent, upgradient floodplain. However, Total PAH concentrations within these samples are below the probable effect values and within the range observed in the Upstream dataset. This indicates that the tar-like material is likely confined to the floodplain and is not significantly impacting the river.

6.1.1.3 Downstream Data

The single station in the Downstream dataset has low concentrations of both metals, PAHs, and PCBs. The concentration of barium exceeds the NOAA background level used in lieu of a low effect screening level (since a toxicity based value was not identified), but is well within the range observed in the Upstream dataset. The same observation is true for Total PCBs and Total PAHs; levels are above low effect screening levels, but within the range observed in the Upstream dataset.

6.1.2 Comparison to Ohio SRVs

Great Miami River sediment concentrations were also compared against Ohio-specific SRVs which were developed to represent regional background sediment concentrations for lotic (flowing) water bodies. According to OEPA guidance (OEPA, 2003), the SRVs may be used in lieu of site-specific background concentrations for sediments. Table 6-1 presents a comparison of the sediment concentrations for the inorganic compounds that were retained in the benchmark comparison against the SRVs for the Eastern Corn Belt Plains eco-region. Any inorganic constituents detected in the Adjacent dataset without screening values or in excess of the low effect screening levels were evaluated relative to the SRVs. SRVs were not developed for organic compounds so this comparison is focused on inorganic compounds. No SRV has been developed for cyanide. In addition, in order to help place the Adjacent surficial sediment data into a regional context, the Upstream and Downstream data were also compared to the Ohio SRVs to determine whether these portions of the river were consistent with the Eastern Corn Belt Plains eco-region.

Comparison of the Upstream dataset to the Ohio SRVs indicates that concentrations of arsenic, beryllium, cadmium, manganese, selenium, and thallium are below the SRVs, indicating that concentrations within this dataset are consistent with levels observed within reference areas in the Eastern Corn Belt Plains eco-region. Concentrations of barium, chromium, copper, iron, lead, mercury, nickel and zinc in the Upstream dataset exceeded the SRV at least once. All SRV exceedances were observed in the two most upstream locations (GMRSD19 and GMRSD30).

Comparison of Adjacent data to the Ohio SRVs indicates that concentrations of arsenic, cadmium, and nickel adjacent to the Site within the Great Miami River are below the associated SRVs. Therefore, levels of these inorganic compounds are consistent with levels observed within reference areas within the Eastern Corn Belt Plains eco-region and these compounds do not require further evaluation.

Concentrations of the remaining metals within the Adjacent dataset exceed the associated SRV at least once. In many cases there is only a single exceedance of the SRV (barium, chromium, manganese, thallium). Beryllium, copper, iron, lead, mercury, selenium, and zinc concentrations within the Adjacent dataset are present above the SRV at multiple stations throughout this portion of the river. Sampling locations GMRSD9, GMRSD26, and GMRSD5 have the most frequent exceedances of the SRVs. Concentrations of metals in the following stations adjacent to the Site were never present above the SRVs: GMRSD27, GMRSD4, GMRSD7, GMRSD3, GMRSD24, GMRSD22, GMRSD2, GMRSD21, GMRSD20, and GMRSD8.

All concentrations detected in the single Downstream sampling location were also below the SRVs.

These results indicate that concentrations of some inorganic constituents within both the Upstream and the Adjacent datasets are above the SRVs. Within both datasets there are several sampling locations where all concentrations are consistent with the SRVs.

6.1.3 SEM and AVS Data Evaluation

Although analysis of SEM, AVS, and TOC data alone is not a completely comprehensive metric of bioavailability, an evaluation of these data is useful as a preliminary indicator of whether or not selected inorganic substances (divalent metals) are likely to be bioavailable in sediments. Therefore, SEM, AVS, and TOC data were collected and analyzed at the majority of the sediment sampling locations. These samples were collected from the top four cm of sediment in order to help assess whether or not selected divalent metals are likely to be bioavailable, and therefore potentially toxic, to benthic receptors.

The basis of the equilibrium partitioning (EqP) approach for deriving screening criteria for metals in sediments is that metal partitioning occurs in sediments between solid and aqueous phases. Sulfides play a critical role in the partitioning of metals in sediments. The majority of sulfides in sediments are present as solid phase iron monosulfides and disulfides (pyrite). Monosulfides are considerably more reactive than disulfides. The most labile sulfidic fraction in sediments consists of the AVS. This fraction is associated with the iron and manganese monosulfides. Iron and manganese sulfides readily dissolve in interstitial pore water in the presence of divalent metals. Conversely, many other metal sulfides are quite insoluble. Insoluble metal sulfide complexes (solid phase) tend to have low bioavailability and therefore low toxicity for aquatic organisms.

Divalent metals in sediments will bind to available AVS in order of increasing solubility. Copper, lead, cadmium, zinc, and nickel will bind to available AVS and be sequentially converted to copper sulfide, lead sulfide, cadmium sulfide, zinc sulfide, and nickel sulfide (i.e., in the order of increasing solubility). This reaction takes place as long as sulfides, in particular AVS, are available. If the molar sum of divalent cations (i.e., copper, lead, cadmium, zinc, and nickel) is less than the molar concentration of available AVS, these metals will exist as metal sulfides. Such metal sulfides are insoluble and are not present in sediment pore water. Therefore, sediments with higher concentrations of AVS than metals will tend to exhibit low metals toxicity. Conversely, when the molar sum of the metals is greater than the molar AVS concentration, the portion of the metals in excess of the AVS concentration can potentially exist as free metals, and thus can potentially be bioavailable and toxic.

The equilibrium partitioning sediment benchmark (ESB) document for metals mixtures (U.S. EPA, 2005) suggests using the difference (SEM minus AVS) rather than the ratio (SEM:AVS) for evaluation of metals bioavailability in sediments. The U.S. EPA (2005) evaluation of metals bioavailability also evaluates possible binding of metals not just by AVS, but also by organic matter. The enhancements to the SEM-AVS approach presented in U.S. EPA (2005) include calculating the difference between the total SEM and the total AVS, then normalizing this fraction (the sum SEM-AVS fraction) to the amount of organic carbon present in the sediment. This approach is presented as $(\Sigma SEM\text{-}AVS)/f_{oc}$, where f_{oc} is the fraction of organic carbon in the sediment sample. This method accounts for binding phases other than AVS, such as the fraction organic carbon.

Under the proposed U.S. EPA (2005) approach, the (ΣSEM-AVS)/f_{oc} values can be compared to literature values for which toxicity has (or has not) been observed for invertebrate receptor species. The ESB document for metals mixtures (U.S. EPA, 2005) suggests use of the following scale to evaluate whether or not the organic carbon binding phase, in conjunction with the AVS, is affecting the bioavailability of metals in sediment:

- If the (ΣSEM-AVS)/f_{oc} excess exceeds 3000 μmol/g_{oc}, the sediments are presumed to be "likely to be toxic";
- If the (ΣSEM-AVS)/f_{oc} excess is between 130 and 3,000 μmol/g_{oc}, predictions of effects are uncertain; and
- If the (ΣSEM-AVS)/f_{oc} excess is less than 130 μmol/g_{oc}, the sediments are presumed to "not likely" be toxic.

Table 6-2 presents a summary of the SEM and AVS data evaluation. Three samples within the Upstream dataset had SEM - AVS levels above 0, indicating that metals could be bioavailable in these locations. All other locations had SEM - AVS levels below 0, indicating that the divalent metals are unlikely to be bioavailable.

When the influence of organic carbon is considered, the bioavailability of the divalent metals is even more limited. None of the samples had an (ΣSEM-AVS)/f_{oc} value above 3000 μmol/g_{oc} where the sediments are presumed to "likely" be toxic (U.S. EPA, 2005). One sample (GMRSD30 in the Upstream dataset) had an (ΣSEM-AVS)/f_{oc} value above 130 μmol/g_{oc}. but below 3000 μmol/g_{oc}, the range where the prediction of effects is uncertain. All other samples had (ΣSEM-AVS)/f_{oc} values below 130 μmol/g_{oc}.

Results of the SEM and AVS analysis indicate that the levels of AVS alone are sufficient to bind the divalent metals in the majority of the samples, including all of the Adjacent dataset. Organic carbon appears to decrease the bioavailability of the metals further, such that the only sample with potentially bioavailable metals is present in the Upstream dataset.

6.1.4 Summary of Sediment Data Evaluation

Additional sediment sampling in the GMR in 2007 was initiated in support of refining the understanding of the potential for Site-related impact to the ecology of the GMR. The additional sediment data resulted in conclusion that there were impacted sediments upstream as well as adjacent to and downstream of the site. This effort achieved confirmation that the GMR is a historically and currently industrialized river and chemical impacts in sediment exist and conclusion cannot be drawn (with sediment data alone) regarding the potential for impact as a result of release from the Site to GMR sediment. It was determined, however, that upstream impacts are equal and in some cases greater than impacts to sediment adjacent to the site.

As a result, it was determined that a fish and macroinvertebrate survey be conducted to determine if the ecology of the system was measurably impacted by residual COPCs in GMR sediment (site-related or otherwise). The presence and measurement of COPCs in GMR sediment indicated the potential for ecological risk and the need to collect additional lines of evidence to support conclusion regarding such risk. USEPA, OEPA and AK Steel agreed that direct measurement of endemic populations was the most direct approach to quantifying the potential ecological risk associated with sediments of the GMR upstream, adjacent and downstream of the site.

6.2 Great Miami River Fish and Benthos

For the purpose of this assessment, the biological criteria data were utilized directly and are presented in Appendix B. The data were considered in a CERCLA context in the weight-of-evidence ERA evaluation. Multimetric biological indices such as the Index of Biotic Integrity (IBI), modified Index of Well-Being (MIwb), and the Invertebrate Community Index (ICI) are considered "bright-line" indicators of the potential for ecological risk. Per OEPA guidance, if the results of these indices indicates that performance expectations for the near-Site reaches of the river (as outlined in OEPA guidance and administrative code (OAC 37456-1-07, Table 7-17)) are met (*i.e.*, full attainment of a designated use, no substantial difference from upstream reference conditions), then no additional ecological risk analysis is warranted in the GMR. Conversely, if the results suggest only partial-attainment or non-attainment of expectations, than additional risk analysis activities may be warranted to determine whether or not the observed impacts are related to exposure to chemical stressors which may have originated at the Former ARMCO facility.

Community index scores, QHEI scores, and applicable ecoregion biocriteria values are summarized in Table 12-Appendix B. For the purposes of biological assessment and determination of attainment of warmwater habitat (WWH) biocriteria, locations were grouped into four distinct sampling areas (containing at least one fish and one macroinvertebrate sampling location), based on proximity to one another. The four sampling areas include the upstream reference location (containing GMRF30, GMRSD30, 29, and 28) and three areas adjacent to and/or downstream of the AK Steel Hamilton Site: upper (GMRF27 and GMRSD27), middle (GMRF25 and GMRSD26, 25, 24, and 22), and lower (GMRF20R, GMRF20L, and GMRSD21, 20, and 23). Attainment of the applicable biocriteria values was determined based on the average index scores within a given area.

All IBI and IWBmod WWH criteria were attained at the sampling locations, except at GMRF27, where the IBI failed to attain the criterion of 42 (Table 12-Appendix B). Although GMRF27 met the IBI criterion in September (40), with Insignificant Departure (see Section 2.4-Appendix B), the considerably lower IBI score in October (34) resulted in non-attainment of the IBI at this location (Table 4-Appendix B). However, the lower IBI score at GMRF27 in October was mirrored at the upstream reference location (GMRF30) where the IBI also dropped by 6 points from September to October. As such, attainment of the IBI criterion at the upstream reference location, GMRF30, was achieved only when considering Insignificant Departure.

Except for GMRSD26 and 21, all remaining benthic macroinvertebrate sampling locations either actually attained the ICI biocriterion or the results suggested that attainment was achieved via the median QCTV (Table 12-Appendix B). In addition, collectively, the benthic community attained or suggested attainment in each of the four primary study areas.

OEPA has evaluated criteria associated with biological response signature identification (Yoder and Rankin, 1995; Yoder and DeShon, 2003). Although bioassessment is not diagnostic to the extent that specific impairments can be readily attributed to specific causative factors, patterns have been identified in fish and benthic communities that apply to broad categories of impairment such as, Complex Toxic, Channelization, Agricultural Non-point Source, and Organic/Nutrient impacts (Yoder and Rankin, 1995). This suggests that toxic impairment was not a limiting factor or the cause of the lower observed index scores at GMRF27.

Yoder and DeShon (2003) demonstrated that exceeding just three of the above macroinvertebrate thresholds strongly suggests complex toxic impairment. As with the fish community analysis, results from the only two locations that did not attain the ICI biocriterion, GMRSD26 and 21, exhibit no such relationship. These results do suggest the presence of impacts related to organic/nutrient loading as evidenced by the higher values for Percent Organic/Nutrient/DO Tolerant taxa at GMRSD26 and 21. However, it is unlikely that impacts of this nature are related to the AK Steel Hamilton Site. On the contrary, impacts associated with organic/nutrient loading are likely attributable to urban and agricultural land uses in the watershed and possibly the pooled nature of the habitat at these two locations.

6.2.1 Summary of GMR Biological Data Evaluation

The presence of site-related COPCs in sediment of the GMR indicated the need for direct measurement of endemic populations in the river and the quantification of community health via the development of Community index scores, QHEI scores, and applicable ecoregion biocriteria values for the GMR upstream, adjacent and downstream of the site.

Collectively, any effects of the AK Steel Hamilton Site appear to have little or no impact on the aquatic community in adjacent portions of the GMR. This was demonstrated by the fact mean IBI, IWBmod, ICI and median QCTV scores among all potential impact locations attained or suggested attainment of the established biocriteria. Adjacent and downstream index scores were generally similar to the upstream reference site (Table 12-Appendix B). In addition, based on mean IBI and IWBmod scores and actual ICI scores, the fish and benthic communities at two of the four potential impact locations (GMRF25 and GMRF20L) met the narrative classification for very good (OEPA 2006b) and met all **exceptional** warmwater habitat (EWH) biocriteria.

Per OEPA guidance, if the results of these indices indicates that performance expectations for the near-Site reaches of the river (as outlined in OEPA guidance and administrative code (OAC 37456-1-07, Table 7-17) are met (*i.e.*, full attainment of a designated use, no substantial difference from upstream reference conditions), then no additional ecological risk analysis is warranted in the GMR. OEPA agreed with the findings of this report in May, 2008 (OEPA, 2008d). As a result, no further ecological risk analysis is considered warranted in the GMR.

6.3 AOC 22 – Riparian Floodplain

To date, no ecological evaluation of the riparian floodplain adjacent to the GMR (AOC 22) has been conducted. Potential AOC 22 surface soil exposures were initially evaluated by calculating screening hazard quotients (HQs). Screening HQs were calculated (Table 6-3) by comparing the maximum detected concentration of each constituent in surface soil to the appropriate ecological screening value using the following formula:

Hazard Quotient = Maximum Detected Concentration/Ecological Screening Value

When the HQ is less than 1 (*i.e.*, the exposure point concentration is less than the benchmark toxicity value), the COPC exposure is assumed to fall below the range considered to be associated with adverse effects for growth, reproduction, or survival of individual receptors, and no population level risks are assumed to be present. For HQ values greater than 1, further evaluation of potential risk may be warranted, depending upon factors such as the quality and quantity of the potentially affected habitat, the nature and magnitude of exceedences, etc.

Exceedances of the ecological screening values may indicate the need for further evaluation of the potential ecological risks posed by the site, but does not necessarily imply an ecological risk. The decision concerning the necessity for further evaluation requires the weighing of such factors as the frequency, magnitude, and pattern of these exceedences. 95%UCLs of the arithmetic mean were developed for all COPCs in AOC 22 soils (Appendix F) that had a Maximum HQ >1 and hazard quotients were re-calculated. Mercury, nickel, selenium, fluoranthene and pyrene (Table 6-3) had 95%UCL HQs that were less than 1.

The COPCs present in AOC 22 soils (i.e., inorganic compounds and SVOCs) above ESVs are common contaminants in and along river floodplain habitats. Consideration is also given to the fact that the number of exceedances of SVOCs above the ESV is less than six (Table 6-3) for all COPCs except Naphthalene (which is 6 exceedances). These compounds were not ecologically significant in on site soils and although these compounds are present in AOC 22 soils; inorganic compounds are naturally occurring and the SVOCs are detected infrequently. Further quantification of ecological exposure and risk above background as a result of these common contaminants along a River floodplain when similar site-related risks have been shown to not be present on site or in the adjacent river, is not warranted.

In addition, the ecological habitat provided in AOC 22 is not of high ecological quality or significance. AOC 22 consists of a significant slope that runs between the site and the GMR floodplain that, by definition, is in a constant state of change. The AOC 22 slope habitat does have some tree and shrub cover, however, as a result of the slope, there are more desirable habitat areas nearby. Debris consisting of brick, stone, wood and similar materials, exists along much of the slope of AOC 22 which further limits the desirability of habitat for ecological receptors. The potential for significant ecological exposure in AOC 22 soils is limited.

The only PBTs in AOC 22 soils detected above background are mercury and PCBs. PCBs have been detected to a limited extent in site soils, a greater extent in GMR sediments and below ESVs in AOC 22 (riparian floodplain) surface soils. On-site mercury and PCB levels were not determined to be a potentially significant ecological risk as a result of exposure to terrestrial on-site surface soils in the SLERA (ENSR, 2008). Upstream sources of mercury and PCBs in GMR sediment have been established and have the potential to redistribute and deposit along the floodplain during storm events. The PCB concentrations measured in AOC 22 surface soils did not exceed the site ESV for PCBs and the sample locations for mercury and PCBs were along the floodplain that is frequently influenced by rises in water levels of the River. Floodplains are a known deposition area for sediments that are disturbed and redistributed during a storm event. A food-web analysis of PBTs in AOC 22 soils is not considered warranted based upon: 1) the presence of upstream sources of PBTs as identified in upstream sediment samples of the GMR, 2) a limited presence of PBTs in sediment and soil samples adjacent to the site or potentially site-related, 3) the limited presence of mercury and PCBs in AOC 22 soils, and 4) the integrity of the benthic biological community in the GMR (Appendix B).

7.0 Uncertainty Analysis

The supplemental biological, physical and chemical data collected in the GMR and AOC 22 were designed to reduce uncertainty in the BERA and to support refined conclusion regarding:

- Estimates of potential risks from the exposure to site-related ecological COPCs;
- An evaluation of the potential bioavailability of divalent cationic metals;
- An evaluation of the health of the macroinvertebrate community relative to the upstream reaches of the Great Miami River Study Area and relative to regional reference conditions established by OEPA; and
- An evaluation of the health of the fish community relative to the upstream reaches of the Great Miami River Study Area and relative to regional reference conditions established by OEPA.

In spite of the collection of site-specific biological data to reduce the uncertainty in drawing conclusions regarding ecological risk at a site, uncertainty will exist as a result of the risk assessment process itself. Assumptions made during site investigation activities, data collection, laboratory processing, data interpretation and presentation and ultimately data manipulation all have the potential to introduce uncertainty to the ERA process. The major sources of uncertainty in a risk assessment include the potential for errors in assumptions, analyses, and in making measurements. Another source of uncertainty lies in the variability inherent in the components of the ecosystem being evaluated. A certain amount of uncertainty arising from the study design, analyses, and measurements is accounted for with the weight-of-evidence evaluation.

The sampling scheme, ecological endpoints, and study design have been developed to fill data gaps and refine the conclusions of the risk assessment. However, a number of assumptions are still made. Although the uncertainties may potentially over or under-estimate risk for a site, the BERA has been designed to serve as a conservative approximation of the potential for ecological risk, and therefore likely over-estimates the potential for risk through use of a number of conservative assumptions.

7.1 Data Evaluation

Use of ½ the reported sample quantitation limit (SQL) to represent undetected constituents introduces uncertainty into the calculation of EPCs. Depending upon the site-specific distribution of data, this factor may result in an under-estimate (i.e., if the true concentration is less than the SQL but exceeds ½ the SQL) or over-estimate (i.e., if the true concentration is less than ½ the SQL) of potential risks.

It is also possible that detection limits for some chemicals are elevated above the ecological screening values.

7.2 Screening COPCs

Ecotoxicological screening values were not available for several compounds that were found in sediment and it was not possible to estimate potential risks from exposure to these constituents. In addition, it is possible that some compounds are present in environmental media at concentrations below detection limits. These factors are likely to result in an under-estimate of potential risks.

The risk screening is based on the assumption that all contaminants are 100% bioavailable and that the most sensitive life stages of all organisms are present. The screening values are very conservative and often based on toxicity tests performed with very sensitive test organisms. These factors are likely to overestimate the actual risk to receptors at the site.

The ecological screening values used do not generally account for possible synergistic, antagonistic, or additive effects of contaminant mixtures. These factors may result in an under-estimate or over-estimate of potential risks.

Many of the ecological screening values used are based on direct or indirect toxicity to lower trophic level receptors. The exception is that many of the U.S. EPA Eco-SSLs and the Region 5 ESVs, particularly for soil, incorporate impacts to vertebrate wildlife in the derivation of the screening values. This may result in an over-estimate of risks to lower trophic level receptors. In cases where screening values for bioaccumulative compounds were based on impacts to lower trophic level receptors, these compounds were retained, even when concentrations were below the screening values. Concentrations of mercury and total PCBs in soil were below screening levels based on plants, but were retained as bioaccumulative compounds. However, the habitat quality within the soil exposure areas is limited, the land is zoned for future industrial development, and potentially complete ecological exposure pathways are limited. Therefore, risks to higher trophic level receptors in these areas are unlikely.

The simple "hazard quotient" approach used provides a conservative estimate of risk based on a "snapshot" of site conditions by considering site concentrations and conservative screening levels.

Several of the sediment screening values were developed using the equilibrium partitioning (EqP) approach. As detailed in U.S. EPA (1993), this approach involves numerous chemical, biological, and toxicological assumptions, all of which have associated uncertainties.

It was assumed that receptors would be exposed to a maximum concentration EPC in the COPC screen. However, in reality it is unlikely any receptor would be exposed continuously to maximum concentrations of constituents. This results in an over-estimate of potential risks at the Site.

7.3 Background Evaluation

The Great Miami River is a large river with an active commercial, industrial, and agricultural watershed. Sediment samples were collected from stations located from upstream to the tip of the Southern Parcel. These samples were collected to represent several different potential exposure areas: upstream of potential Site impact; adjacent to AOC 7; and adjacent to the Southern Parcel. The discussion of upstream (background) concentrations of constituents is intended to identify uncertainties in the evaluation of sediment data in the risk assessment.

Figures 6-1, 6-2, and 6-3 show the HQs in sediment for inorganics, PAHs, and PCBs, respectively. A review of HQs from upstream to downstream indicates that the Great Miami River upstream of the Site has constituents present at concentrations high enough to pose a potential ecological risk (i.e., the HQs upstream of the Site exceed 1). This indicates that there are likely upstream sources, unrelated to Site influences, which are contributing to sediment contaminant levels within the Great Miami River. These figures demonstrate that there are clearly additional sources of contaminants upstream of the Site, as indicated by HQs exceeding 1 in upstream sediments. This is most notable for the inorganics where the average HQ in the most upstream sample (GMRSD19) is significantly higher than all but one of the potentially Site-related samples.

The GMR upstream sources of COPCs that are being investigated at the site introduces significant uncertainty in the evaluation of potential site-related impact on the river. As a result, multiple lines of evidence are collected in an attempt to characterize the ecological condition of the river. It is assumed that the precise determination of the impact of potential site-related discharge to the river that occurred over a number of decades, cannot be accurately quantified. As a result, the bioassessment of river species (i.e., benthic invertebrates and fish) is used to indicate the "health" of the system and its ability to support endemic species. The presence of these species in good condition, sufficient numbers and desired diversity supports the position that no measurable site-related impact (above background or baseline conditions) exists in the GMR. There is considerable uncertainty in the development of such an approach as well as the collection and interpretation of data that has the potential to both over- and under-estimate ecological risk.

7.4 Compound Bioavailability

The presence of compounds in environmental matrices (e.g., sediment) at concentrations which exceed benchmark screening values does not necessarily constitute ecological risk. For instance, certain compounds may not be absorbed through direct contact due to the chemical form.

To help identify whether or not inorganic substances are potential stressors of concern in sediments at the Site simultaneously extracted metals (SEM) and acid volatile sulfides (AVS) data were collected. Iron and manganese sulfides readily dissolve in interstitial pore water in the presence of divalent metals. Conversely, many other metal sulfides are quite insoluble. Insoluble metal sulfide complexes (solid phase) tend to have low bioavailability and therefore low toxicity for aquatic organisms. Uncertainty is introduced with the use of SEM-AVS to predict bioavailability in sediment. It is not an exact measurement of bioavailability.

Other measurements do not address the bioavailability of COPCs. It is possible that some COPCs, while present at concentrations exceeding benchmarks or otherwise not passing screening measurements, are actually not bioavailable and thus do not pose risk to ecological receptors. The incorporation of these compounds into the BERA can result in an over-estimation of risk at the site.

7.5 Uncertainties Associated with Natural System Variability

Numerous factors may influence the bioavailability of constituents in the environment. In sediment, for example, factors such as pH, redox potential, sediment texture, and dissolved organic carbon concentrations may affect COPC bioavailability. Various biological processes in all media can also affect COPC bioavailability. Although it is likely not the case, in accordance with EPA guidance, COPCs are conservatively assumed to be 100% bioavailable for the purposes of this ERA. Numerous factors that were not evaluated may also influence the population dynamics of the selected receptors. Factors such as habitat modification, off-site contaminant migration/deposition, temporal and seasonal fluctuations, and natural population fluctuations may influence populations and communities of these ecological receptors. Non-chemical stressors, such as the presence of slag within some AOCs, may also limit populations of ecological receptors. Lastly, the property is zoned industrial and it is assumed that future uses of the terrestrial portions of the Site will be industrial, thereby limiting the potential for complete ecological exposure pathways under future foreseeable conditions.

The analytical results may not be representative of all site conditions across four seasons. This may result in an overestimation or underestimation of the risk. However, given the large number of samples available for evaluation, this uncertainty likely would not alter the BERA conclusions.

8.0 Summary and Conclusions

The Great Miami River is an industrialized River that has historically received and continues to receive point source discharges of industrial and municipal wastewater as well as non-point sources such as stormwater runoff. The accumulation of chemical pollutants such as PAHs, metals and PCBs in the sediments of rivers flowing through populated and industrialized areas is well documented. The Great Miami River is an example of such a river. Select metals, PAHs, and PCBs are present throughout the river (including Upstream of the Site) at concentrations above ecologically based low effect values. Levels of barium, chromium, copper, iron, lead, mercury, nickel, and zinc in the Upstream dataset exceed SRVs. SEM, AVS, and TOC data, however, indicate that the divalent metals within the Adjacent dataset and within most of the Upstream dataset are not likely to be bioavailable.

Additional sediment sampling in the GMR in 2007 was initiated in support of refining the understanding of the potential for site-related impact to the ecology of the GMR. The additional sediment data resulted in conclusion that there were impacted sediments upstream as well as adjacent to and downstream of the site. Sediment samples located to evaluate the potential for AOC 7 surface water and AOC 13 groundwater to discharge into the Great Miami River indicate that COPCs associated with these AOCs are not elevated within the river sediments in these areas. In addition, the samples located in the vicinity of the tar-like materials in the floodplain (AOC 22) do not contain significantly elevated levels of PAHs indicating that the tar-like material is not significantly impacting the river. This sediment sampling effort achieved confirmation that the GMR is a historically and currently industrialized river and chemical impacts in sediment exist. As a result, it was determined that a fish and macroinvertebrate survey be conducted to determine if the ecology of the system was measurably impacted by residual COPCs in GMR sediment (site-related or otherwise). The presence and measurement of COPCs in GMR sediment indicate the potential for ecological risk and the need to collect additional lines of evidence to support conclusion regarding such risk. USEPA, OEPA and AK Steel agreed that direct measurement of endemic populations was the most direct approach to quantifying the potential ecological risk associated with sediments of the GMR upstream, adjacent and downstream of the site.

The direct measurement of endemic populations in the river and the quantification of community health via the development of Community index scores, QHEI scores, and applicable ecoregion biocriteria values for the GMR upstream, adjacent and downstream of the site was conducted in 2007. It was determined that the AK Steel Hamilton Site appears to have little or no impact on the aquatic community in adjacent portions of the GMR. This was demonstrated by the fact mean IBI, IWBmod, ICI and median QCTV scores among all potential impact locations attained or suggested attainment of the established biocriteria. Adjacent and downstream index scores were generally similar to the upstream reference site (Table 12-Appendix B). In addition, based on mean IBI and IWBmod scores and actual ICI scores, the fish and benthic communities at two of the four potential impact locations (GMRF25 and GMRF20L) met the narrative classification for very good (OEPA 2006b) and met all exceptional warmwater habitat (EWH) biocriteria. Per OEPA guidance, if the results of these indices indicates that performance expectations for the near-Site reaches of the river (as outlined in OEPA guidance and administrative code (OAC 37456-1-07, Table 7-17)) are met (*i.e.*, full attainment of a designated use, no substantial difference from upstream reference conditions), then no additional ecological risk analysis is warranted in the GMR.

The only PBTs in AOC 22 soils and GMR sediment above background are mercury and PCBs. PCBs have been detected to a limited extent in site soils, a greater extent in GMR sediments (including upstream) and below ESVs in AOC 22 (riparian floodplain) surface soils. The low effect screening value for Total PCBs is exceeded in samples collected throughout the Great Miami River, including Upstream of the Site. On-site mercury and PCB levels were not determined to be a potentially significant ecological risk as a result of exposure to terrestrial on-site surface soils in the SLERA (ENSR, 2008). PCBs in the upstream GMR sediments have been shown to exist at levels above that measured in the River sediment adjacent to the site. Upstream sources of mercury and PCBs in GMR sediment have the potential to redistribute and deposit along the floodplain during storm events. The PCB concentrations measured in AOC 22 surface soils did not exceed the site ESV for PCBs and the sample locations for mercury and PCBs were along the floodplain that is frequently influenced by rises in water levels of the River. Floodplains are a known deposition area for sediments that are disturbed and redistributed during a storm event.

Based upon the ecological data collected, PBTs are not considered a significant threat in the GMR or AOC 22 as a result of site activities or releases to the River. A food-web analysis of PBTs (i.e., PCBs) is not considered warranted based upon: 1) the presence of upstream sources of PBTs as identified in upstream sediment samples, 2) a limited presence of PBTs in sediment samples adjacent to the site or potentially site-related, 3) the limited presence of PBTs in site soils adjacent to or near the River (AOC 22), 4) low quality ecological habitat in AOC 22, and 4) the integrity of the benthic biological community in the GMR. The on-site soils do not present a mercury or PCB ecological risk and population level reproductive effects were not observed in the biological community assessment of the GMR (Appendix B). PCBs detected below the ESV and infrequent detections of mercury in AOC 22 (floodplain) soils in between the site and the GMR are not considered site-related or significant.

Soils of AOC 22 reveal the presence of similar compounds (low levels of inorganics, PAHs and PCBs) found in GMR sediments. It is not known if the compounds are a result of historical site release, background conditions, or deposition during a high water event in the GMR. The concentrations present are low, often at low frequency and the compounds (aside from mercury and PCBs addressed above) are not considered bioaccumulative or of significant threat to the GMR food web. The presence of low levels of COPCs along the river may represent background conditions of the river system and be the result of sediment redistribution in the river during storm events. Further quantification of ecological exposure and risk above background as a result of these common contaminants along a River floodplain when similar site-related risks have been shown to not be present on site or in the adjacent river, is not warranted.

The presence of organic and inorganic COPCs above probable effect screening values in GMR sediment resulted in a biocriteria survey that was conducted to evaluate the potential impacts that these stressors might be having on the macroinvertebrate and finfish community. The community specific data, index scores, associated Qualitative Habitat Evaluation Index (QHEI) results, and other habitat observations indicate that the former ARMCO Hamilton plant site has not adversely affected the biological communities in adjacent and downstream portions of the Great Miami River. No further assessment of sediment or riparian soil data in or near the GMR is anticipated as a result of the available data and a conclusion of "no effect" that resulted from the quantitative evaluation of sediment dwelling organisms (macro invertebrates) and fish in the GMR (KEMRON and EA Engineering, 2008). OEPA review of the Work Plan for this effort resulted in approval for AK Steel to "consider a "no effects" survey result as an off-ramp to further investigation of the Great Miami River for this site" (OEPA, 2007).

Based on the body of data presented in this ecological risk assessment, including, but not limited to, the absence of threatened and endangered species at the Site; the documented absence of impact to the river biota and achievement of exceptional warmwater habitat biocriteria in the river; documented upstream sediment concentrations of COCs; absence of significant or high quality ecological habitat within the riparian area; and, absence of significant PBT detections in the study area, no significant ecological risk is present to warrant additional evaluation or action at the Site.

Therefore, it is concluded that no further ecological investigation of or response action for the AK Steel Former ARMCO Hamilton Plant facility or the Great Miami River is warranted for this site under CERCLA and the NCP.

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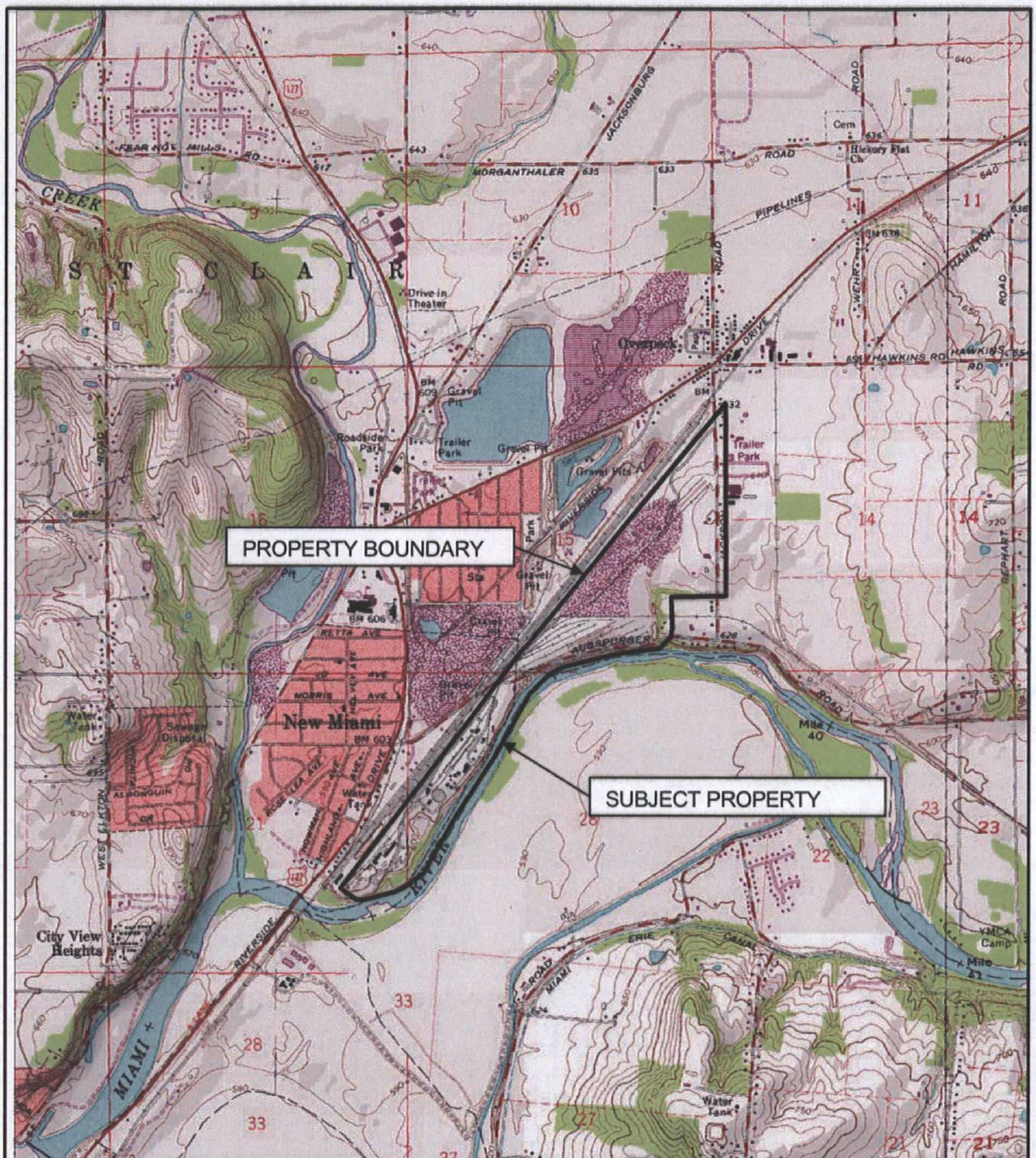
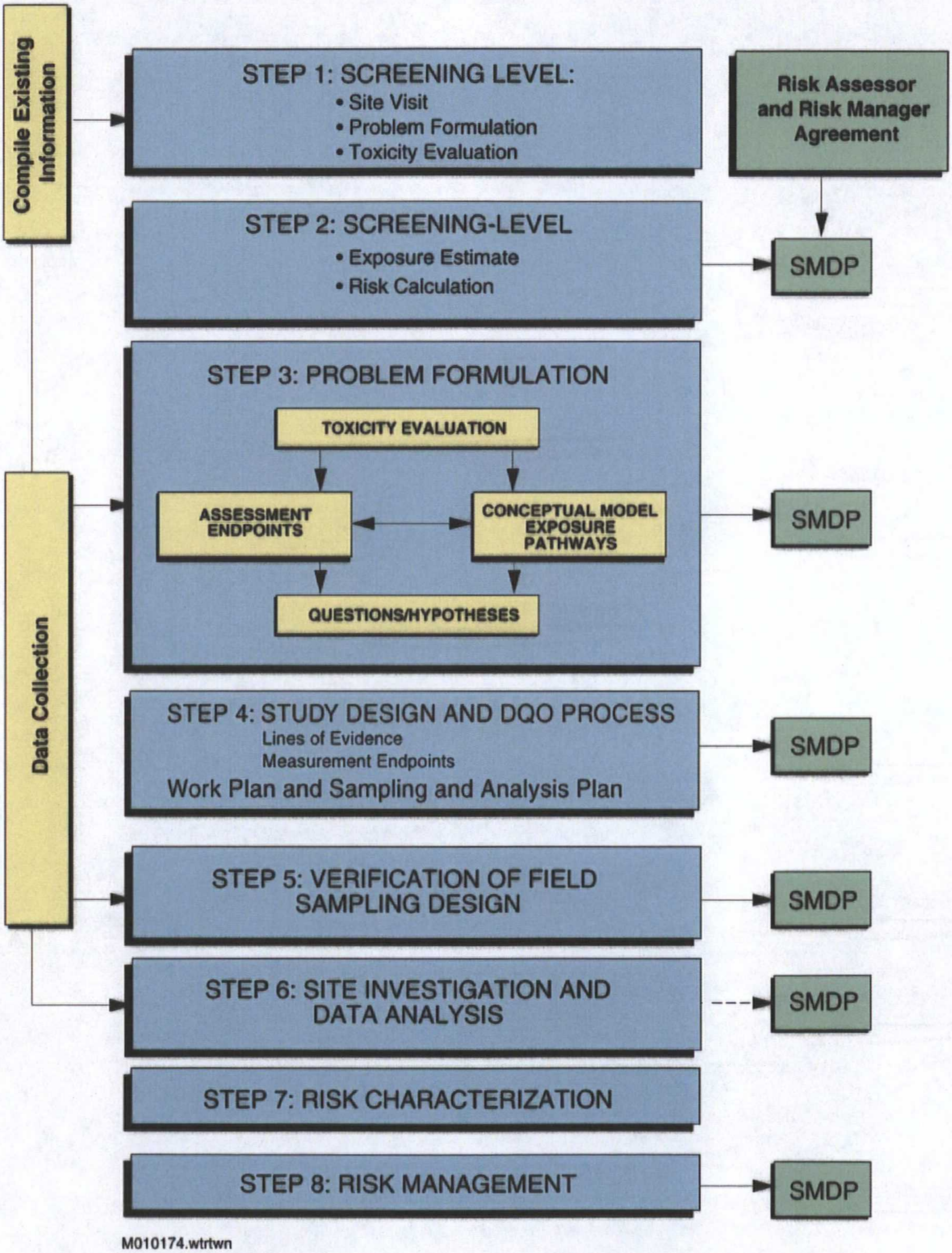
FIGURES



Scale: 1:25,000	AK Steel Former Armco Hamilton Plant Hamilton, Ohio Quadrangle 1988	**Site Locus Map** Hamilton, Ohio July 2006 Project #: MR0507	**Figure 1-1** Kemron ENVIRONMENTAL SERVICES

Figure 1-2 U.S. EPA Eight-Step Ecological Risk Assessment Process



Note: SMDP=Scientific Management Decision Point

Legend

Sample Locations

- Sediment
- Background Sediment
- Surface Water
- Background Surface Water
- Groundwater

AK Steel Parcels

N
W
E
S

Historic Aquatic Sampling Locations

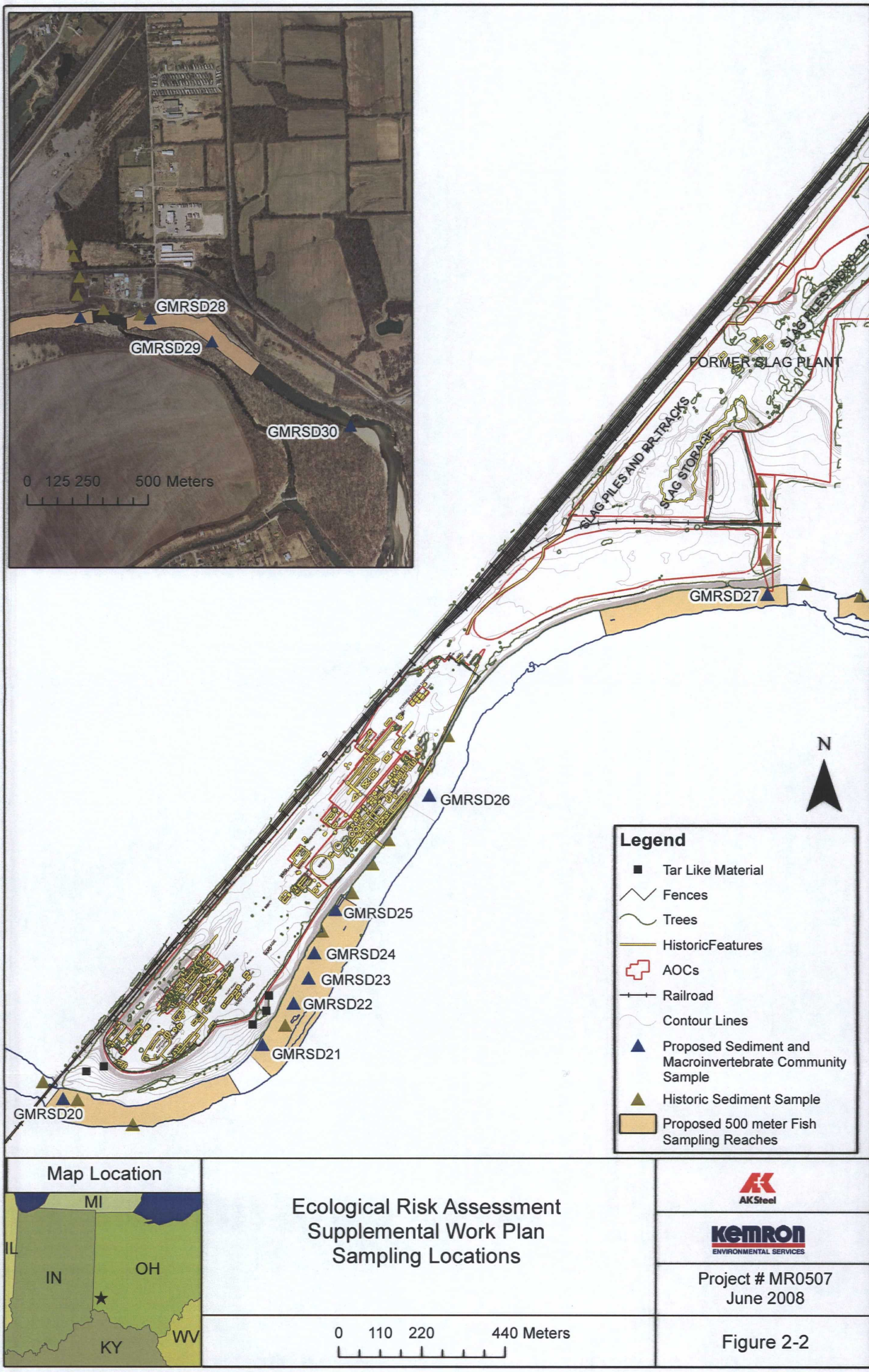
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

SCALE	DATE	PROJECT NO.
1:14400	08/07	00076-069

KEMRON ENVIRONMENTAL SERVICES

Figure Number

2-1



Ecological Risk Assessment
Supplemental Work Plan
Sampling Locations

Project # MR0507
June 2008

Figure 2-2

0 500 1,000 Feet

Figure 2-3

AK Steel Hamilton, OH
2007 Sediment and Ecological Sampling Locations

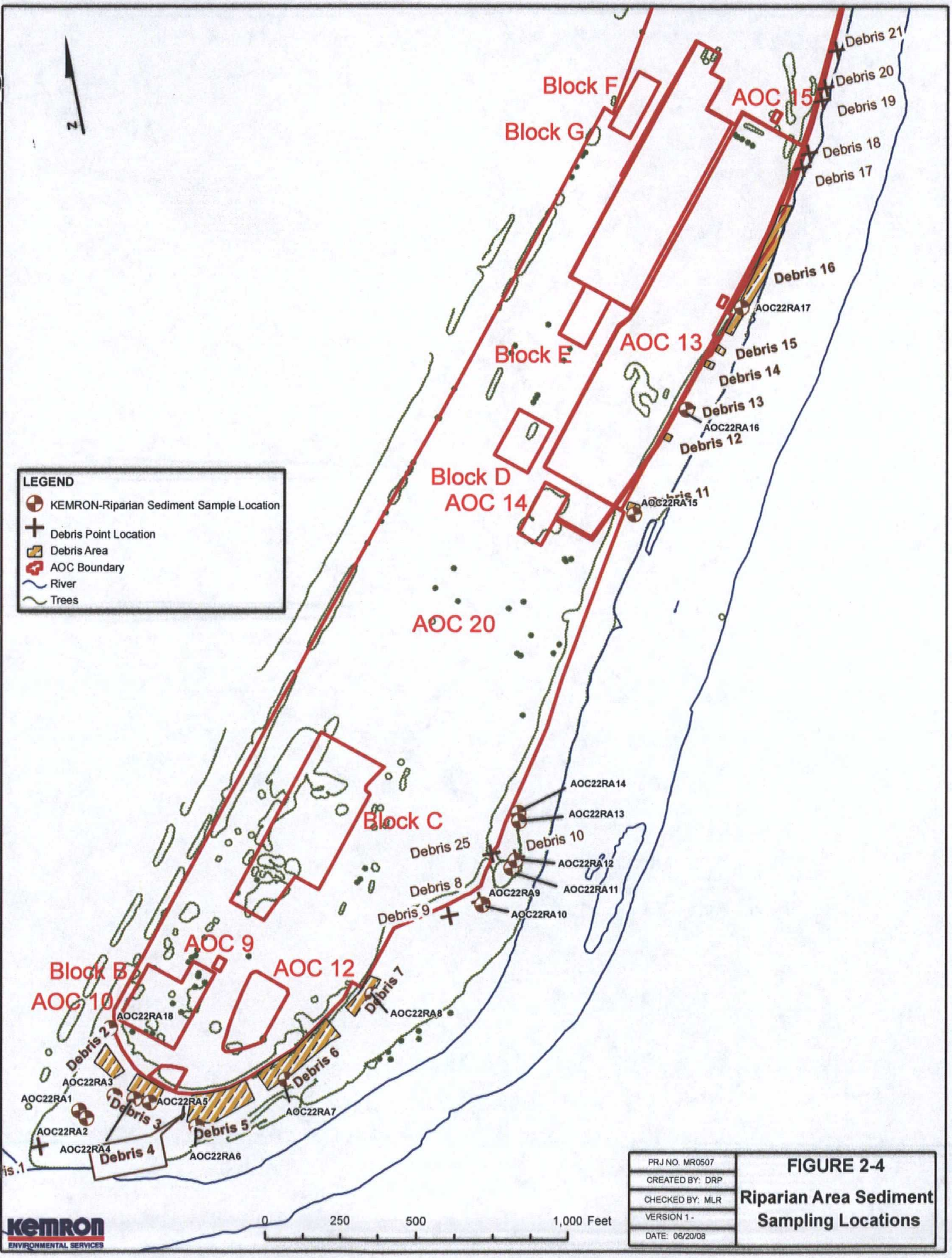


FIGURE 2-4
Riparian Area Sediment Sampling Locations

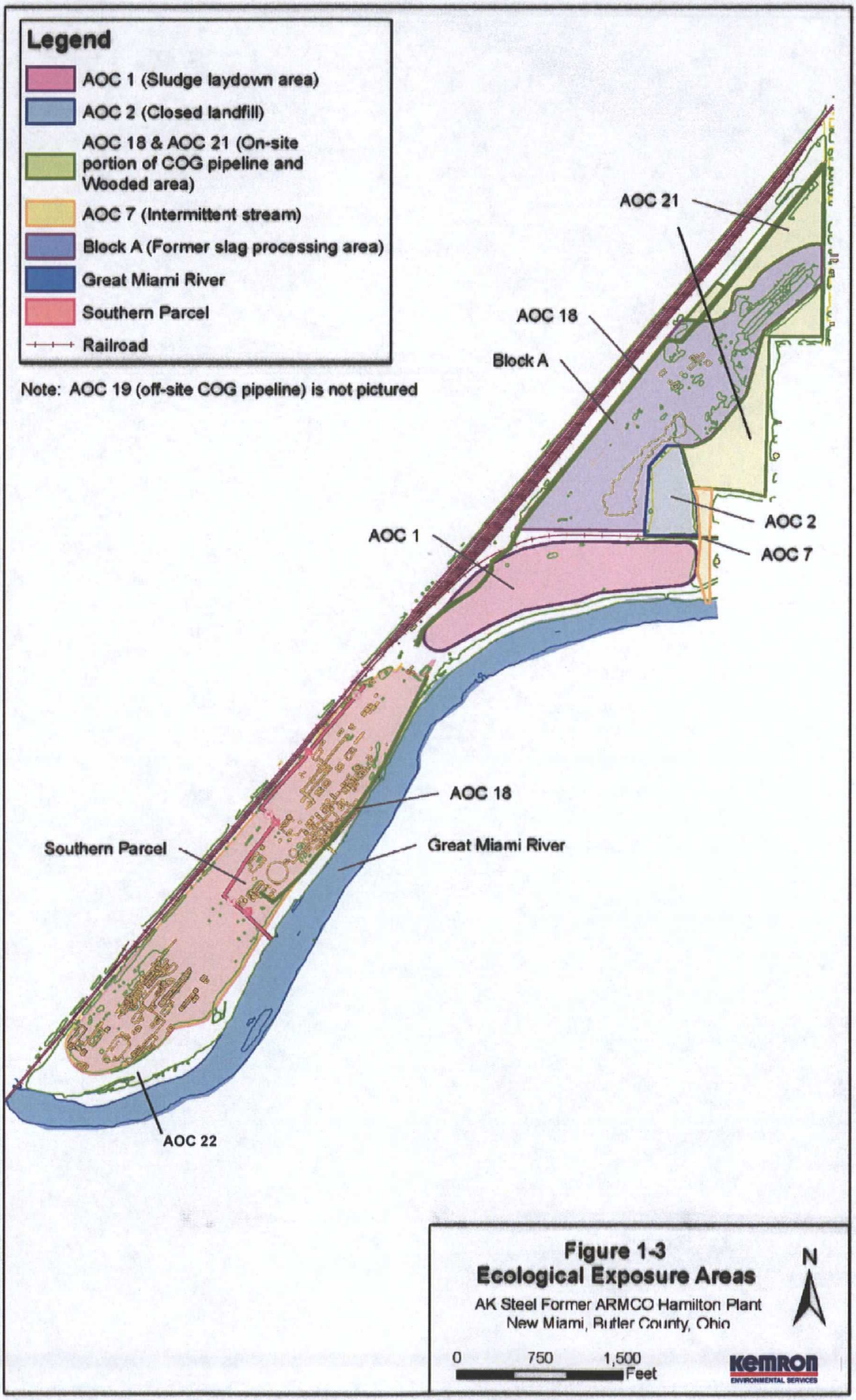
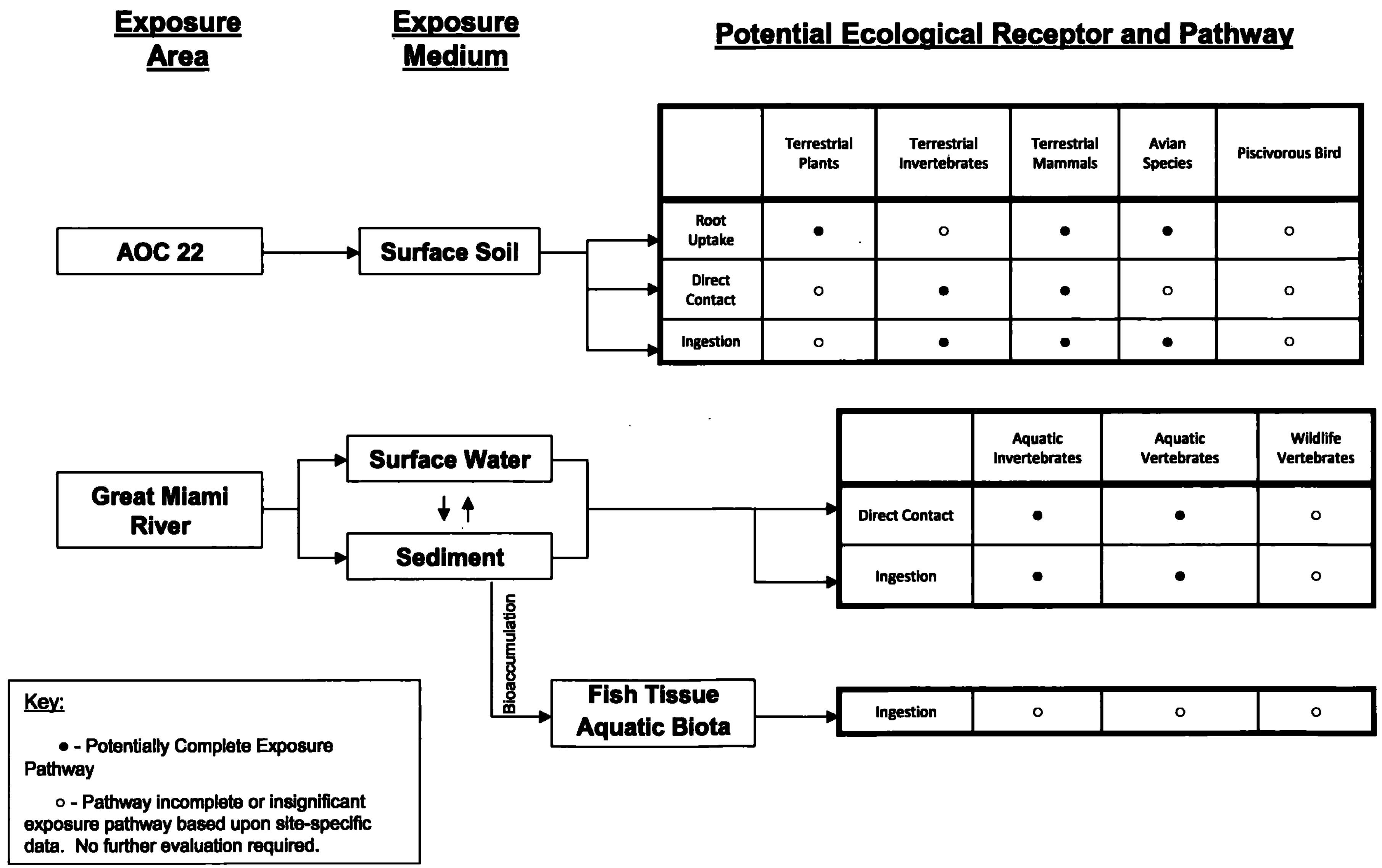


Figure 1-3
Ecological Exposure Areas
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

Figure 3-1. BERA Conceptual Site Model

AK Steel – Former Armco Hamilton Plant
New Miami, Butler County, Ohio



	Terrestrial Plants	Terrestrial Invertebrates	Terrestrial Mammals	Avian Species	Piscivorous Bird
Root Uptake	●	○	●	●	○
Direct Contact	○	●	●	○	○
Ingestion	○	●	●	●	○

	Aquatic Invertebrates	Aquatic Vertebrates	Wildlife Vertebrates
Direct Contact	●	●	○
Ingestion	●	●	○

Ingestion	○	○	○

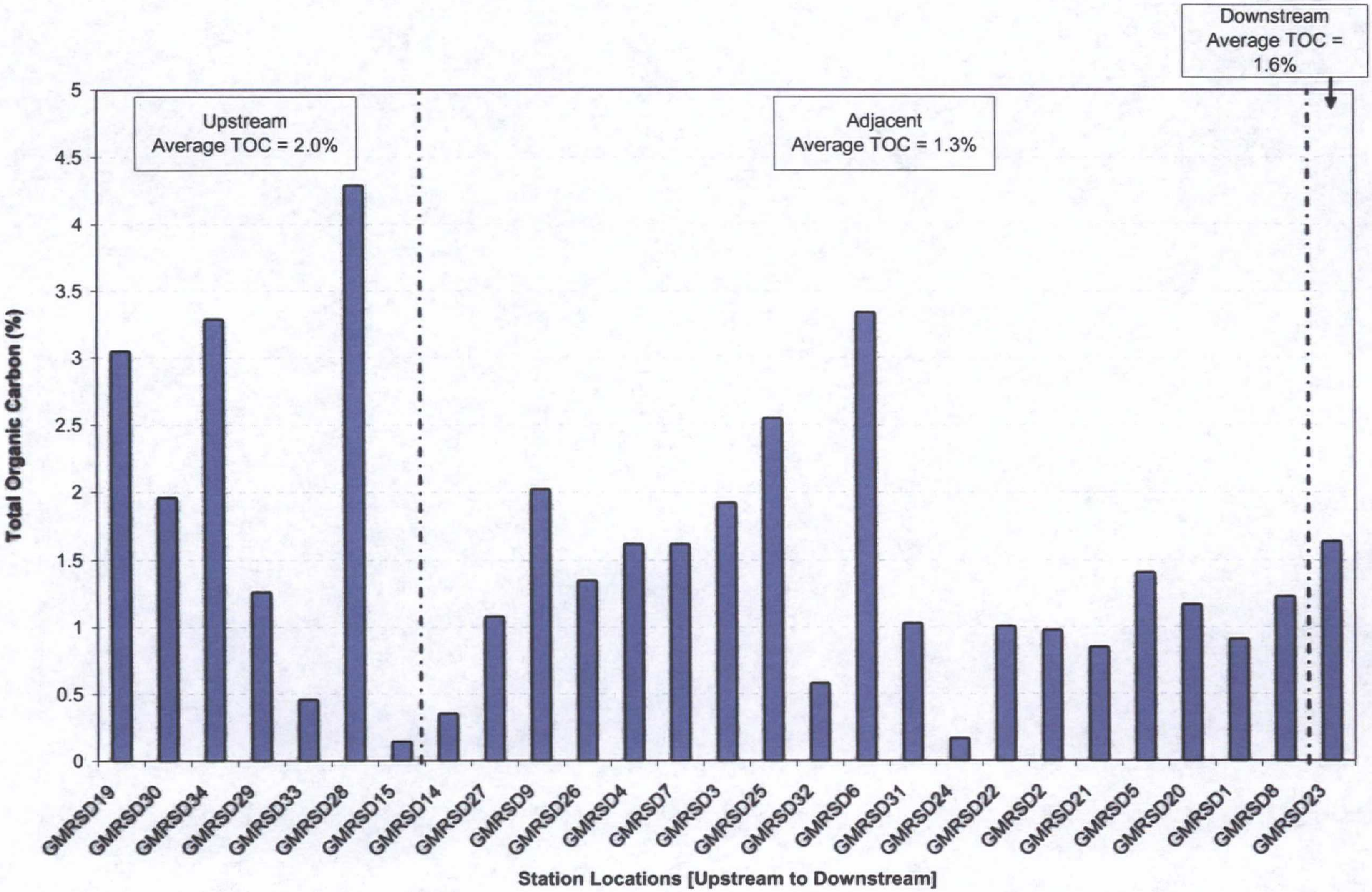


Figure 5-1 Total Organic Carbon Content in Great Miami River Sediments

TABLES

Table 2-1
Potentially Complete Ecological Exposure Pathways
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Exposure Pathway	AOC22	Great Miami River
Surface Soil		
Direct contact with surface soil by terrestrial plants and invertebrates	X [1]	O
Root uptake from surface soil by terrestrial plants	X [1]	O
Incidental ingestion of soil by vertebrate wildlife [2]	X [2]	O
Ingestion of prey items which have bioaccumulated constituents from soil by vertebrate wildlife [2]	X [2]	O
Sediments		
Direct contact with sediment by aquatic or benthic invertebrates	O	X [1]
Direct contact with sediment by aquatic vertebrates (e.g. fish)	O	X [1]
Incidental ingestion of sediment by vertebrate wildlife [2]	O	X [2]
Ingestion of prey items which have bioaccumulated constituents from sediment by vertebrate wildlife [2]	O	X [2]
Surface Water		
Direct contact with surface water by aquatic invertebrates	O	O
Direct contact with surface water by fish	O	O
Incidental ingestion of surface water by vertebrate wildlife [2]	O	O
Ingestion of prey items which have bioaccumulated constituents from surface water by vertebrate wildlife [2]	O	O
Ground Water		
Discharge of groundwater to surface water and direct contact by aquatic invertebrates and fish.	O	O

X = Potentially complete exposure pathway.
O = Incomplete or insignificant exposure pathway, no further evaluation recommended.

1 - Exposure pathways evaluated in the SLERA.
2 - Several ecological screening levels incorporate impacts to vertebrate wildlife via food web exposure.

Table 2-2
Assessment and Measurement Endpoints
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Assessment Endpoint/Measurement Endpoint	AOC22	Great Miami River
1) Sustainability of a terrestrial plant and invertebrate community which reflects the available habitat in the Site's upland areas and can serve as a forage base for higher trophic level receptors.		
a) Comparison of terrestrial soil concentrations to soil quality screening benchmarks. Measurement of concentrations in excess of soil quality screening benchmarks will be considered indicators of potential effects on plants and/or invertebrates.	X	
2) Sustainability of a healthy and well-balanced benthic invertebrate community which is typical of comparable Ohio habitats with similar structure, morphology, and hydrology.		
a) Comparison of bulk sediment analytical chemistry results to sediment quality benchmarks. Measurement of concentrations in excess of sediment quality benchmarks will be considered indicative of a potential for ecological risks to benthic receptors.		X
b) Characterization of sediment metals bioavailability based on simultaneously extracted metals (SEM)/acid volatile sulfides (AVS) relationships. SEM/AVS ratios greater than 1 in a sediment sample will be considered an indicator of potential bioavailability for divalent cationic metals.		X
3) Sustainability of a healthy and well-balanced aquatic receptor community (e.g., fish and aquatic invertebrates) which is typical of comparable Ohio aquatic resource areas with similar structure, morphology, and hydrology.		
a) Evaluate diversity indices for aquatic receptor community (fish and aquatic invertebrates). Measurements that do not meet OEPA standards will be considered indicators of potential effects on aquatic receptors.		X
b) Evaluate sediment at potential point source release locations from the site to the GMR (AOC7 and AOC19). Measurements of concentrations in excess of upstream conditions will be considered indicators of potential effects on aquatic receptors.		X

Table 2-3
Samples Evaluated in the BERA
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Exposure Area	Medium	Sample Location ID		
AOC 22	SO	AOC22RA1	AOC22RA7	AOC22RA13
AOC 22	SO	AOC22RA2	AOC22RA8	AOC22RA14
AOC 22	SO	AOC22RA3	AOC22RA9	AOC22RA15
AOC 22	SO	AOC22RA4	AOC22RA10	AOC22RA16
AOC 22	SO	AOC22RA5	AOC22RA11	AOC22RA17
AOC 22	SO	AOC22RA6	AOC22RA12	AOC22RA18
Great Miami River	SE	GMRSD1	GMRSD15	GMRSD27
Great Miami River	SE	GMRSD2	GMRSD19	GMRSD28
Great Miami River	SE	GMRSD3	GMRSD20	GMRSD29
Great Miami River	SE	GMRSD4	GMRSD20dup	GMRSD30
Great Miami River	SE	GMRSD5	GMRSD21	GMRSD31
Great Miami River	SE	GMRSD6	GMRSD22	GMRSD31dup
Great Miami River	SE	GMRSD7	GMRSD23	GMRSD32
Great Miami River	SE	GMRSD8	GMRSD24	GMRSD33
Great Miami River	SE	GMRSD9	GMRSD25	GMRSD34
Great Miami River	SE	GMRSD14	GMRSD26	

SO = Surface Soil
SE = Surficial Sediment

See Figures 2-2 and 2-3 for sample locations.

Table 2-4
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Inorganics					
Aluminum	7429-90-5	2600	[9]	NV	[10,24]
Antimony	7440-36-0	2	[7]	0.27	[10,23]
Arsenic	7440-38-2	9.79	[5]	18	[10]
Barium	7440-39-3	0.7	[9]	330	[10]
Beryllium	7440-41-7	NV		21	[10,23]
Cadmium	7440-43-9	0.99	[5]	0.36	[10,23]
Calcium	7440-70-2	NV		NV	
Chromium (total)	7440-47-3	43.4	[5]	26	[10,23]
Cobalt	7440-48-4	50	[4,22]	13	[10]
Copper	7440-50-8	31.6	[5]	28	[10,23]
Cyanide	57-12-5	0.1	[4,22]	1.33	[4,23]
Iron	7439-89-6	20000	[6]	NV	[10,25]
Lead	7439-92-1	35.8	[5]	11	[10,23]
Magnesium	7439-95-4	NV		NV	
Manganese	7439-96-5	460	[6]	500	[11]
Mercury	7439-97-6	0.18	[5]	0.3	[11]
Nickel	7440-02-0	22.7	[5]	28	[10]
Potassium	7440-09-7	NV		NV	
Selenium	7782-49-2	2	[13]	1	[11]
Silver	7440-22-4	1	[7]	4.2	[10,23]
Sodium	7440-23-5	NV		NV	
Thallium	7440-28-0	NV		1	[11]
Vanadium	7440-62-2	NV		7.8	[10,23]
Zinc	7440-66-6	121	[5]	50	[11]
Organics					
Semivolatile Organic Compounds					
Acenaphthene	83-32-9	0.15	[7]	20	[11]
Acenaphthylene	208-96-8	0.00587	[4,22]	682	[4,23]
Anthracene	120-12-7	0.0572	[5]	1480	[4,23]
Benzo(a)anthracene	56-55-3	0.108	[5]	5.21	[4,23]
Benzo(a)pyrene	50-32-8	0.15	[5]	1.52	[4,23]
Benzo(b)fluoranthene	205-99-2	10.4	[4]	59.8	[4,23]
Benzo(g,h,i)perylene	191-24-2	0.17	[6]	119	[4,23]
Benzo(k)fluoranthene	207-08-9	0.24	[6]	148	[4,23]
Chrysene	218-01-9	0.166	[5]	4.73	[4,23]
Dibenz(a,h)anthracene	53-70-3	0.033	[5]	18.4	[4,23]
Fluoranthene	206-44-0	0.423	[5]	122	[4,23]
Fluorene	86-73-7	0.0774	[5]	122	[4,23]
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	[6]	109	[4,23]
Naphthalene	91-20-3	0.176	[5]	0.0994	[4,23]
Phenanthrene	85-01-8	0.204	[5]	45.7	[4,23]
Pyrene	129-00-0	0.195	[5]	78.5	[4,23]
Total PAHs	Total PAHs	1.61	[5]	1.0	[12]
1,1-Biphenyl	92-52-4	NV		60	[11]
2,2'-Oxybis(1-Chloropropane)	108-60-1	NV		19.9	[4,23]
2,4,5-Trichlorophenol	95-95-4	NV		4	[11]
2,4,6-Trichlorophenol	88-06-2	0.208	[4]	9.94	[4,23]
2,4-Dichlorophenol	120-83-2	0.0817	[4]	87.5	[4,23]
2,4-Dimethylphenol	105-67-9	0.304	[4]	0.01	[4]
2,4-Dinitrophenol	51-28-5	0.00621	[4]	20	[11]
2-Chloronaphthalene	91-58-7	0.417	[4]	0.0122	[4,23]
2-Chlorophenol	95-57-8	0.0319	[4]	0.243	[4,23]
2-Methylnaphthalene	91-57-6	0.0202	[4,22]	3.24	[4,23]
2-Nitroaniline	88-74-4	NV		74.1	[4,23]
2-Nitrophenol	88-75-5	0.0133	[4,18]	5.12	[4,18]
2,4-Dinitrotoluene	121-14-2	0.0144	[4]	1.28	[4,23]
2,6-Dinitrotoluene	606-20-2	0.0398	[4]	0.0328	[4,23]
3,3'-Dichlorobenzidine	91-94-1	0.127	[4]	0.646	[4,23]
3-Nitroaniline	99-09-2	NV		3.16	[4,23]
4,6-Dinitro-2-methylphenol	534-52-1	0.104	[4]	0.144	[4,23]
4-Bromophenylphenyl ether	101-55-3	1.2	[8]	NV	
4-Chloro-3-methylphenol	59-50-7	0.388	[4]	7.95	[4,23]
4-Chloroaniline	106-47-8	0.146	[4]	1.1	[4,23]
4-Chlorophenylphenyl ether	7005-72-3	NV		NV	
4-Nitroaniline	100-01-6	NV		21.9	[4,23]
4-Nitrophenol	100-02-7	0.0133	[4]	5.12	[4,23]
Acetophenone	98-86-2	NV		300	[4,23]
Atrazine	1912-24-9	NV		0.00005	[12]

Table 2-4
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Benzaldehyde	100-52-7	NV		NV	
Bis(2-Chloroethoxy)methane	111-91-1	NV		0.302	[4,23]
Bis(2-Chloroethyl)ether	111-44-4	3.52	[4]	23.7	[4,23]
Bis(2-Ethylhexyl)phthalate	117-81-7	890	[8]	0.925	[4,23]
Bromodichloromethane	75-27-4	NV		0.54	[4,23]
Butylbenzylphthalate	85-68-7	11	[8]	0.239	[4,23]
Carbazole	86-74-8	NV		NV	
Dibenzofuran	132-64-9	0.42	[8]	NV	
Diethylphthalate	84-66-2	0.6	[4]	100	[11]
Dimethylphthalate	131-11-3	0.6	[4,19]	734	[4,23]
Di-n-butylphthalate	84-74-2	1.114	[4]	200	[11]
Di-n-octylphthalate	117-84-0	40.6	[4]	709	[4,23]
N-nitrosodi-n-propylamine	621-64-7	NV		0.544	[4,23]
N-Nitrosodiphenylamine	86-30-6	NV		0.545	[4,23]
o-Cresol (2-Methylphenol)	95-48-7	0.012	[8]	40.4	[4,23]
p-Cresol (4-Methylphenol)	106-44-5	0.0202	[4]	163	[4,23]
Pentachlorophenol	87-86-5	23	[4]	3	[11]
Phenol	108-95-2	0.0491	[4]	70	[11]
Volatile Organic Compounds					
1,1,1-Trichloroethane	71-55-6	0.030	[8]	29.8	[4,23]
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NV		NV	
1,1-Dichloroethane	75-34-3	0.027	[8]	20.1	[4,23]
1,1-Dichloroethene	75-35-4	0.031	[8]	8.28	[4,23]
1,2,4-Trichlorobenzene	120-82-1	9.6	[8]	11.1	[4,23]
1,2-Dibromo-3-chloropropane	96-12-8	NV		0.0352	[4,23]
1,2-Dibromoethane	106-93-4	NV		1.23	[4,23]
1,2-Dichlorobenzene	95-50-1	0.33	[8]	2.96	[4,23]
1,2-Dichloroethane	107-06-2	0.26		0.000000212	[4,23]
1,3-Dichlorobenzene	541-73-1	1.7	[8]	37.7	[4,23]
1,4-Dichlorobenzene	106-46-7	0.34	[8]	0.546	[4,23]
2-Butanone	78-93-3	0.27	[8]	89.6	[4,23]
2-Hexanone	591-78-6	0.022	[8]	12.6	[4,23]
4-Methyl-2-pentanone	108-10-1	0.033	[8]	443	[4,23]
Acetone	67-64-1	0.0087	[8]	2.5	[4,23]
Benzene	71-43-2	0.16	[8]	0.255	[4,23]
Bromomethane	74-83-9	0.137	[4]	0.235	[4,23]
Caprolactam	105-60-2	NV		NV	
Carbon disulfide	75-15-0	0.00085	[8]	0.0941	[4,23]
Carbon tetrachloride	56-23-5	0.047	[8]	2.98	[4,23]
Chlorobenzene	108-90-7	0.41	[8]	13.1	[4,23]
Chloroethane	75-00-3	NV		NV	
Chloroform	67-66-3	0.022	[8]	1.19	[4,23]
Chloromethane	74-87-3	NV		10.4	[4,23]
cis-1,2-Dichloroethene	156-59-2	0.40	[8,14]	0.784	[4,21]
cis-1,3-Dichloropropene	10061-01-5	0.000051	[8,20]	0.398	[4,23]
Cyclohexane	110-82-7	NV		0.1	[12]
Dibromochloromethane	124-48-1	NV		2.05	[4,23]
Dichlorodifluoromethane	75-71-8	NV		39.5	[4,23]
Ethylbenzene	100-41-4	0.089	[8]	5.16	[4,23]
Hexachlorobenzene	118-74-1	0.02	[4,22]	0.199	[4,23]
Hexachlorobutadiene	87-68-3	0.0265	[4]	0.0398	[4,23]
Hexachlorocyclopentadiene	77-47-4	0.901	[4]	0.755	[4,23]
Hexachloroethane	67-72-1	1.0	[8]	0.596	[4,23]
Isopropylbenzene	98-82-8	NV		NV	
m+p Xylene	XYLMP	0.025	[8,15]	NV	
Methyl acetate	79-20-9	NV		NV	
Methylcyclohexane	108-87-2	NV		NV	
Methylene chloride	75-09-2	0.37	[8]	4.05	[4,23]
Methyl-tert-butyl-ether	1634-04-4	NV		NV	
Nitrobenzene	98-95-3	0.145	[4]	1.31	[4,23]
o-Xylene	95-47-6	0.025	[8,15]	NV	
Styrene	100-42-5	0.254	[4]	4.69	[4,23]
Tetrachloroethene	127-18-4	0.41	[8]	9.92	[4,23]
Toluene	108-88-3	0.050	[8]	200	[11]
trans-1,2-Dichloroethene	156-60-5	0.40	[8,14]	0.784	[4,23]
trans-1,3-Dichloropropene	10061-02-6	0.000051	[8,20]	0.398	[4,23]
Trichloroethene	79-01-6	0.22	[8]	12.4	[4,23]
Trichlorofluoromethane	75-69-4	NV		16.4	[4,23]
Vinyl chloride	75-01-4	0.20[illegible]	[4]	0.646	[4,23]

Table 2-4
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Xylenes (total)	1330-20-7	0.16	[8]	10	[4]
Polychlorinated Biphenyls					
Total PCBs	Total PCBs	0.0598	[5]	40	[11]
Dioxins/Furans					
Polychlorinated dibenzofurans	51207-31-9	NV		0.0000386	[4,23]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	0.00000012	[4]	0.000000199	[4,23]
Polychorinated dibenzo-p-dioxins	PCDDs	0.000011	[4]	0.000000199	[4,23]

CAS - Chemical Abstracts Service
Eco-SSL - Ecological Soil Screening Level
ERL - Effects Range Low
ER-L - Effects Range-Low
ESL - Ecological Screening Level
ESV - Ecological Screening Value
LCV - Lowest Chronic Value
LEL - Lowest Effect Level
NV - Screening value not identified
OAC - Ohio Administrative Code
ORNL - Oak Ridge National Laboratory
PAH - Polycyclic Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyl
SCV - Secondary Chronic Value
TEC - Threshold Effect Concentration
TOC - total Organic Carbon
WQC - Water Quality Criteria

Screening value sources and notes
[2] ORNL SCV for aquatic biota (Suter and Tsao, 1996).
[3] ORNL LCV for aquatic biota (Suter and Tsao, 1996).
[4] Region 5 ESLs (U.S. EPA 2003a; Available at http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf).
Equilibrium partitioning based sediment ESLs presented in this table are adjusted to a default TOC of 1%. ESLs used in screening are adjusted to site-specific TOC.
[5] TEC from MacDonald, et al. (2000).
[6] LEL from Ontario Ministry of the Environment (Persaud, et al. 1996).
[7] ER-Ls from Long and Morgan (1990).
[8] ORNL SCV for sediment-associated biota (Jones et al., 1997) adjusted to default of 1% TOC. SCVs adjusted to site-specific TOC for screening.
[9] Value from NOAA's Screening Quick Reference Table (Buchman, 1999).
[10] U.S. EPA Eco-SSL. Value selected is the lower of the values derived for soil invertebrates, plants, birds, and mammals.
[11] ORNL screening benchmark for terrestrial plants (Efroymson, et al., 1997); values for earthworms are higher.
[12] Region 4 Ecological Screening Values (U.S. EPA, 2001; Available at http://www.epa.gov/region4/waste/ots/ecolbul.htm).
[13] Region 3 Ecological Screening Values (U.S. EPA, 2006; Available at http://www.epa.gov/reg3hwmd/risk/eco/index.htm).
[14] Value for 1,2-dichloroethene used as a surrogate.
[15] Value for m-xylene used as a surrogate.
[16] Value for benzo(a)anthracene used as a surrogate.
[17] Value for benzo(b)fluoranthene used as a surrogate.
[18] Value for 4-nitrophenol used as a surrogate.
[19] Value for diethylphthalate used as a surrogate.
[20] Value for 1,3-dichloropropene used as a surrogate.
[21] Value for trans-1,2-dichloroethene used as a surrogate.
[22] Region 5 sediment ESL not based on equilibrium partitioning.
[23] Screening level based on impacts to higher trophic level receptors.
[24] No numerical Eco-SSL. Toxicity is dependent on soil pH, not total concentration of aluminum.
[25] No numerical Eco-SSL. Toxicity is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions).

Table 3-1
Samples Evaluated In the BERA
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Exposure Area	Medium	Sample Location ID		
AOC 22	SO	AOC22RA1	AOC22RA7	AOC22RA13
AOC 22	SO	AOC22RA2	AOC22RA8	AOC22RA14
AOC 22	SO	AOC22RA3	AOC22RA9	AOC22RA15
AOC 22	SO	AOC22RA4	AOC22RA10	AOC22RA16
AOC 22	SO	AOC22RA5	AOC22RA11	AOC22RA17
AOC 22	SO	AOC22RA6	AOC22RA12	AOC22RA18
Great Miami River	SE	GMRSD1	GMRSD15	GMRSD27
Great Miami River	SE	GMRSD2	GMRSD19	GMRSD28
Great Miami River	SE	GMRSD3	GMRSD20	GMRSD29
Great Miami River	SE	GMRSD4	GMRSD20dup	GMRSD30
Great Miami River	SE	GMRSD5	GMRSD21	GMRSD31
Great Miami River	SE	GMRSD6	GMRSD22	GMRSD31dup
Great Miami River	SE	GMRSD7	GMRSD23	GMRSD32
Great Miami River	SE	GMRSD8	GMRSD24	GMRSD33
Great Miami River	SE	GMRSD9	GMRSD25	GMRSD34
Great Miami River	SE	GMRSD14	GMRSD26	

SO = Surface Soil
SE = Surficial Sediment

See Figures 2-2 and 2-3 for sample locations.

Table 3-2
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Trichlorofluoromethane	75-69-4	NV		16.4	[4,23]
Vinyl chloride	75-01-4	0.202	[4]	0.646	[4,23]
Xylenes (total)	1330-20-7	0.16	[8]	10	[4]
Polychlorinated Biphenyls					
Total PCBs	Total PCBs	0.0598	[5]	40	[11]
Dioxins/Furans					
Polychlorinated dibenzofurans	51207-31-9	NV		0.0000386	[4,23]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	0.00000012	[4]	0.000000199	[4,23]
Polychorinated dibenzo-p-dioxins	PCDDs	0.000011	[4]	0.000000199	[4,23]

CAS - Chemical Abstracts Service
Eco-SSL - Ecological Soil Screening Level
ERL - Effects Range Low
ER-L - Effects Range-Low
ESL - Ecological Screening Level
ESV - Ecological Screening Value
LCV - Lowest Chronic Value
LEL - Lowest Effect Level
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OAC - Ohio Administrative Code
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PAH - Polycyclic Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyl
SCV - Secondary Chronic Value
TEC - Threshold Effect Concentration
TOC - total Organic Carbon
WQC - Water Quality Criteria

Screening value sources and notes
[2] ORNL SCV for aquatic biota (Suter and Tsao, 1996).
[3] ORNL LCV for aquatic biota (Suter and Tsao, 1996).
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Equilibrium partitioning based sediment ESLs presented in this table are adjusted to a default TOC of 1%. ESLs used in screenir are adjusted to site-specific TOC.
[5] TEC from MacDonald, et al. (2000).
[6] LEL from Ontario Ministry of the Environment (Persaud, et al. 1996).
[7] ER-Ls from Long and Morgan (1990).
[8] ORNL SCV for sediment-associated biota (Jones et al., 1997) adjusted to default of 1% TOC. SCVs adjusted to site-specific
[9] Value from NOAA's Screening Quick Reference Table (Buchman, 1999).
[10] U.S. EPA Eco-SSL. Value selected is the lower of the values derived for soil invertebrates, plants, birds, and mammals.
[11] ORNL screening benchmark for terrestrial plants (Efroymson, et al., 1997); values for earthworms are higher.
[12] Region 4 Ecological Screening Values (U.S. EPA, 2001; Available at http://www.epa.gov/region4/waste/ots/ecolbul.htm).
[13] Region 3 Ecological Screening Values (U.S. EPA, 2006; Available at http://www.epa.gov/reg3hwmd/risk/eco/index.htm).
[14] Value for 1,2-dichloroethene used as a surrogate.
[15] Value for m-xylene used as a surrogate.
[16] Value for benzo(a)anthracene used as a surrogate.
[17] Value for benzo(b)fluoranthene used as a surrogate.
[18] Value for 4-nitrophenol used as a surrogate.
[19] Value for diethylphthalate used as a surrogate.
[20] Value for 1,3-dichloropropene used as a surrogate.
[21] Value for trans-1,2-dichloroethene used as a surrogate.
[22] Region 5 sediment ESL not based on equilibrium partitioning.
[23] Screening level based on impacts to higher trophic level receptors.
[24] No numerical Eco-SSL. Toxicity is dependent on soil pH, not total concentration of aluminum.
[25] No numerical Eco-SSL. Toxicity is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions).

Table 3-2
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Atrazine	1912-24-9	NV		0.00005	[12]
Benzaldehyde	100-52-7	NV		NV	
Bis(2-Chloroethoxy)methane	111-91-1	NV		0.302	[4,23]
Bis(2-Chloroethyl)ether	111-44-4	3.52	[4]	23.7	[4,23]
Bis(2-Ethylhexyl)phthalate	117-81-7	890	[8]	0.925	[4,23]
Bromodichloromethane	75-27-4	NV		0.54	[4,23]
Butylbenzylphthalate	85-68-7	11	[8]	0.239	[4,23]
Carbazole	86-74-8	NV		NV	
Dibenzofuran	132-64-9	0.42	[8]	NV	
Diethylphthalate	84-66-2	0.6	[4]	100	[11]
Dimethylphthalate	131-11-3	0.6	[4,19]	734	[4,23]
Di-n-butylphthalate	84-74-2	1.114	[4]	200	[11]
Di-n-octylphthalate	117-84-0	40.6	[4]	709	[4,23]
N-nitrosodi-n-propylamine	621-64-7	NV		0.544	[4,23]
N-Nitrosodiphenylamine	86-30-6	NV		0.545	[4,23]
o-Cresol (2-Methylphenol)	95-48-7	0.012	[8]	40.4	[4,23]
p-Cresol (4-Methylphenol)	106-44-5	0.0202	[4]	163	[4,23]
Pentachlorophenol	87-86-5	23	[4]	3	[11]
Phenol	108-95-2	0.0491	[4]	70	[11]
Volatile Organic Compounds					
1,1,1-Trichloroethane	71-55-6	0.030	[8]	29.8	[4,23]
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NV		NV	
1,1-Dichloroethane	75-34-3	0.027	[8]	20.1	[4,23]
1,1-Dichloroethene	75-35-4	0.031	[8]	8.28	[4,23]
1,2,4-Trichlorobenzene	120-82-1	9.6	[8]	11.1	[4,23]
1,2-Dibromo-3-chloropropane	96-12-8	NV		0.0352	[4,23]
1,2-Dibromoethane	106-93-4	NV		1.23	[4,23]
1,2-Dichlorobenzene	95-50-1	0.33	[8]	2.96	[4,23]
1,2-Dichloroethane	107-06-2	0.26		0.000000212	[4,23]
1,3-Dichlorobenzene	541-73-1	1.7	[8]	37.7	[4,23]
1,4-Dichlorobenzene	106-46-7	0.34	[8]	0.546	[4,23]
2-Butanone	78-93-3	0.27	[8]	89.6	[4,23]
2-Hexanone	591-78-6	0.022	[8]	12.6	[4,23]
4-Methyl-2-pentanone	108-10-1	0.033	[8]	443	[4,23]
Acetone	67-64-1	0.0087	[8]	2.5	[4,23]
Benzene	71-43-2	0.16	[8]	0.255	[4,23]
Bromomethane	74-83-9	0.137	[4]	0.235	[4,23]
Caprolactam	105-60-2	NV		NV	
Carbon disulfide	75-15-0	0.00085	[8]	0.0941	[4,23]
Carbon tetrachloride	56-23-5	0.047	[8]	2.98	[4,23]
Chlorobenzene	108-90-7	0.41	[8]	13.1	[4,23]
Chloroethane	75-00-3	NV		NV	
Chloroform	67-66-3	0.022	[8]	1.19	[4,23]
Chloromethane	74-87-3	NV		10.4	[4,23]
cis-1,2-Dichloroethene	156-59-2	0.40	[8,14]	0.784	[4,21]
cis-1,3-Dichloropropene	10061-01-5	0.000051	[8,20]	0.398	[4,23]
Cyclohexane	110-82-7	NV		0.1	[12]
Dibromochloromethane	124-48-1	NV		2.05	[4,23]
Dichlorodifluoromethane	75-71-8	NV		39.5	[4,23]
Ethylbenzene	100-41-4	0.089	[8]	5.16	[4,23]
Hexachlorobenzene	118-74-1	0.02	[4,22]	0.199	[4,23]
Hexachlorobutadiene	87-68-3	0.0265	[4]	0.0398	[4,23]
Hexachlorocyclopentadiene	77-47-4	0.901	[4]	0.755	[4,23]
Hexachloroethane	67-72-1	1.0	[8]	0.596	[4,23]
Isopropylbenzene	98-82-8	NV		NV	
m+p Xylene	XYLMP	0.025	[8,15]	NV	
Methyl acetate	79-20-9	NV		NV	
Methylcyclohexane	108-87-2	NV		NV	
Methylene chloride	75-09-2	0.37	[8]	4.05	[4,23]
Methyl-tert-butyl-ether	1634-04-4	NV		NV	
Nitrobenzene	98-95-3	0.145	[4]	1.31	[4,23]
o-Xylene	95-47-6	0.025	[8,15]	NV	
Styrene	100-42-5	0.254	[4]	4.69	[4,23]
Tetrachloroethene	127-18-4	0.41	[8]	9.92	[4,23]
Toluene	108-88-3	0.050	[8]	200	[11]
trans-1,2-Dichloroethene	156-60-5	0.40	[8,14]	0.784	[4,23]
trans-1,3-Dichloropropene	10061-02-6	0.000051	[8,20]	0.398	[4,23]
Trichloroethene	79-01-6	0.22	[8]	12.4	[4,23]

Table 3-2
Ecological Screening Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Parameter	CAS No.	Sediment (mg/kg)		Soil (mg/kg)	
Inorganics					
Aluminum	7429-90-5	2600	[9]	NV	[10,24]
Antimony	7440-36-0	2	[7]	0.27	[10,23]
Arsenic	7440-38-2	9.79	[5]	18	[10]
Barium	7440-39-3	0.7	[9]	330	[10]
Beryllium	7440-41-7	NV		21	[10,23]
Cadmium	7440-43-9	0.99	[5]	0.36	[10,23]
Calcium	7440-70-2	NV		NV	
Chromium (total)	7440-47-3	43.4	[5]	26	[10,23]
Cobalt	7440-48-4	50	[4,22]	13	[10]
Copper	7440-50-8	31.6	[5]	28	[10,23]
Cyanide	57-12-5	0.1	[4,22]	1.33	[4,23]
Iron	7439-89-6	20000	[6]	NV	[10,25]
Lead	7439-92-1	35.8	[5]	11	[10,23]
Magnesium	7439-95-4	NV		NV	
Manganese	7439-96-5	460	[6]	500	[11]
Mercury	7439-97-6	0.18	[5]	0.3	[11]
Nickel	7440-02-0	22.7	[5]	28	[10]
Potassium	7440-09-7	NV		NV	
Selenium	7782-49-2	2	[13]	1	[11]
Silver	7440-22-4	1	[7]	4.2	[10,23]
Sodium	7440-23-5	NV		NV	
Thallium	7440-28-0	NV		1	[11]
Vanadium	7440-62-2	NV		7.8	[10,23]
Zinc	7440-66-6	121	[5]	50	[11]
Organics					
Semivolatile Organic Compounds					
Acenaphthene	83-32-9	0.15	[7]	20	[11]
Acenaphthylene	208-96-8	0.00587	[4,22]	682	[4,23]
Anthracene	120-12-7	0.0572	[5]	1480	[4,23]
Benzo(a)anthracene	56-55-3	0.108	[5]	5.21	[4,23]
Benzo(a)pyrene	50-32-8	0.15	[5]	1.52	[4,23]
Benzo(b)fluoranthene	205-99-2	10.4	[4]	59.8	[4,23]
Benzo(g,h,i)perylene	191-24-2	0.17	[6]	119	[4,23]
Benzo(k)fluoranthene	207-08-9	0.24	[6]	148	[4,23]
Chrysene	218-01-9	0.166	[5]	4.73	[4,23]
Dibenz(a,h)anthracene	53-70-3	0.033	[5]	18.4	[4,23]
Fluoranthene	206-44-0	0.423	[5]	122	[4,23]
Fluorene	86-73-7	0.0774	[5]	122	[4,23]
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	[6]	109	[4,23]
Naphthalene	91-20-3	0.176	[5]	0.0994	[4,23]
Phenanthrene	85-01-8	0.204	[5]	45.7	[4,23]
Pyrene	129-00-0	0.195	[5]	78.5	[4,23]
Total PAHs	Total PAHs	1.61	[6]	1.0	[12]
1,1-Biphenyl	92-52-4	NV		60	[11]
2,2'-Oxybis(1-Chloropropane)	108-60-1	NV		19.9	[4,23]
2,4,5-Trichlorophenol	95-95-4	NV		4	[11]
2,4,6-Trichlorophenol	88-06-2	0.208	[4]	9.94	[4,23]
2,4-Dichlorophenol	120-83-2	0.0817	[4]	87.5	[4,23]
2,4-Dimethylphenol	105-67-9	0.304	[4]	0.01	[4]
2,4-Dinitrophenol	51-28-5	0.00621	[4]	20	[11]
2-Chloronaphthalene	91-58-7	0.417	[4]	0.0122	[4,23]
2-Chlorophenol	95-57-8	0.0319	[4]	0.243	[4,23]
2-Methylnaphthalene	91-57-6	0.0202	[4,22]	3.24	[4,23]
2-Nitroaniline	88-74-4	NV		74.1	[4,23]
2-Nitrophenol	88-75-5	0.0133	[4,18]	5.12	[4,18]
2,4-Dinitrotoluene	121-14-2	0.0144	[4]	1.28	[4,23]
2,6-Dinitrotoluene	606-20-2	0.0398	[4]	0.0328	[4,23]
3,3'-Dichlorobenzidine	91-94-1	0.127	[4]	0.646	[4,23]
3-Nitroaniline	99-09-2	NV		3.16	[4,23]
4,6-Dinitro-2-methylphenol	534-52-1	0.104	[4]	0.144	[4,23]
4-Bromophenylphenyl ether	101-55-3	1.2	[8]	NV	
4-Chloro-3-methylphenol	59-50-7	0.388	[4]	7.95	[4,23]
4-Chloroaniline	106-47-8	0.146	[4]	1.1	[4,23]
4-Chlorophenylphenyl ether	7005-72-3	NV		NV	
4-Nitroaniline	100-01-6	NV		21.9	[4,23]
4-Nitrophenol	100-02-7	0.0133	[4]	5.12	[4,23]
Acetophenone	98-86-2	NV		300	[4,23]

Table 4-2
Surface Soil Ecological Screening Evaluation - AOC 22 Exposure Area
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

CAS	Chemical (a)	Units	FOD (b)	Maximum Detected Concentration (c)	Ecological Screening Value	Maximum HQ	Does Maximum Detection Exceed ESV?	Location of Maximum Detection
Inorganics								
7429-90-5	Aluminum	mg/kg	18:18	1.92E+04	(d)	(d)	(d)	AOC22RA14
7440-36-0	Antimony	mg/kg	17:18	***2.49E+00***	0.27	9.2	Yes	AOC22RA8
7440-38-2	Arsenic	mg/kg	18:18	***1.43E+01***	18	0.8	No	AOC22RA4
7440-39-3	Barium	mg/kg	18:18	2.25E+02	330	0.68	No	AOC22RA14
7440-41-7	Beryllium	mg/kg	18:18	3.48E+00	21	0.17	No	AOC22RA14
7440-43-9	Cadmium	mg/kg	18:18	***3.31E+00***	0.36	9	Yes	AOC22RA8
7440-47-3	Chromium (total)	mg/kg	18:18	***9.20E+01***	26	3.5	Yes	AOC22RA16
7440-48-4	Cobalt	mg/kg	18:18	1.03E+01	13	0.79	No	AOC22RA8
7440-50-8	Copper	mg/kg	18:18	***6.55E+01***	28	2.3	Yes	AOC22RA8
7439-89-6	Iron	mg/kg	18:18	6.92E+04	(e)	(e)	(e)	AOC22RA4
7439-92-1	Lead	mg/kg	18:18	***3.41E+02***	11	31	Yes	AOC22RA5
7439-96-5	Manganese	mg/kg	18:18	***3.18E+03***	500	6.4	Yes	AOC22RA10
7439-97-6	Mercury	mg/kg	17:18	***5.78E-01***	0.30	1.93	Yes	AOC22RA8
7440-02-0	Nickel	mg/kg	18:18	***3.35E+01***	28	1.20	Yes	AOC22RA8
7782-49-2	Selenium	mg/kg	14:18	***2.11E+00***	1.0	2	Yes	AOC22RA9
7440-22-4	Silver	mg/kg	12:16	1.06E+00	4.2	0.25	No	AOC22RA8
7440-28-0	Thallium	mg/kg	18:18	6.11E-01	1.0	0.6	No	AOC22RA2
7440-62-2	Vanadium	mg/kg	18:18	***3.05E+01***	7.8	3.9	Yes	AOC22RA4
7440-66-6	Zinc	mg/kg	17:17	***1.36E+03***	50	27	Yes	AOC22RA5
SVOCs								
92-52-4	1,1-Biphenyl	mg/kg	2:18	4.56E+00	60	0.0760	No	AOC22RA2
90-12-0	1-Methylnaphthalene	mg/kg	14:17	5.45E-01	NV	NE	NE	AOC22RA2
91-57-6	2-Methylnaphthalene	mg/kg	17:18	2.68E+00	3.24	0.83	No	AOC22RA2
83-32-9	Acenaphthene	mg/kg	12:18	2.26E+00	682	0.0033	No	AOC22RA2
208-96-8	Acenaphthylene	mg/kg	18:18	2.35E+01	682	0.0345	No	AOC22RA2
120-12-7	Anthracene	mg/kg	18:18	3.32E+01	1480	0.0224	No	AOC22RA2
56-55-3	Benzo(a)anthracene	mg/kg	18:18	***5.01E+01***	5.21	9.62	Yes	AOC22RA11
50-32-8	Benzo(a)pyrene	mg/kg	18:18	***3.76E+01***	1.52	24.7	Yes	AOC22RA11
205-99-2	Benzo(b)fluoranthene	mg/kg	18:18	4.08E+01	59.8	0.68	No	AOC22RA2
191-24-2	Benzo(g,h,i)perylene	mg/kg	18:18	1.81E+01	119	0.152	No	AOC22RA11
207-08-9	Benzo(k)fluoranthene	mg/kg	18:18	3.81E+01	148	0.257	No	AOC22RA11
86-74-8	Carbazole	mg/kg	7:18	9.30E+00	NV	NE	NE	AOC22RA2
218-01-9	Chrysene	mg/kg	18:18	***4.48E+01***	4.73	9.5	Yes	AOC22RA11
53-70-3	Dibenz(a,h)anthracene	mg/kg	18:18	5.63E+00	18.4	0.306	No	AOC22RA11
132-64-9	Dibenzofuran	mg/kg	4:18	2.13E+01	NV	NE	NE	AOC22RA2
206-44-0	Fluoranthene	mg/kg	18:18	***1.44E+02***	122	1.180	Yes	AOC22RA2
86-73-7	Fluorene	mg/kg	17:18	3.31E+01	122	0.2713	No	AOC22RA2
193-39-5	Indeno(1,2,3-cd)pyrene	mg/kg	18:18	1.71E+01	109	0.157	No	AOC22RA11
91-20-3	Naphthalene	mg/kg	18:18	***5.10E+01***	0.0994	513.1	Yes	AOC22RA2
85-01-8	Phenanthrene	mg/kg	18:18	***1.37E+02***	45.7	2.998	Yes	AOC22RA2
129-00-0	Pyrene	mg/kg	18:18	***9.71E+01***	78.5	1.237	Yes	AOC22RA11
Total PAHs	Total PAHs	mg/kg		***5.62E+02***	1.0	562.0	Yes	
VOCs								
67-64-1	Acetone	mg/kg	2:18	3.60E-02	2.5	0.014	No	AOC22RA1
110-82-7	Cyclohexane	mg/kg	1:18	7.30E-02	0.1	0.73	No	AOC22RA18
79-20-9	Methylacetate	mg/kg	2:18	1.20E+00	NV	NE	NE	AOC22RA18
108-87-2	Methylcyclohexane	mg/kg	1:18	2.66E-01	NV	NE	NE	AOC22RA18
108-88-3	Toluene	mg/kg	1:18	1.03E-01	5.45E+00	0.019	No	AOC22RA18
95-47-6	Xylene	mg/kg	1:18	2.65E-02	NV	NE	NE	AOC22RA18
PCBs								
Total PCBs	Total PCBs	mg/kg	18:18	2.37E+00	40	0.059	No	AOC22RA8

Concentrations in boldface italics exceed the ESV. Compounds in light green highlight are consistent with background (Appendix G).
CAS - Chemical Abstract Service.
ESV - Ecological screening value
HQ - Hazard Quotient (Maximum concentration/ESV)
NV - No value identified
NE - Not evaluated due to lack of screening value
Total PCBs is the sum of Aroclor 1248, Aroclor 1254 and Aroclor 1260.
Xylene is the sum of m,p, and o-isomers.
Total PAHs is the sum of the PAHs detected within this exposure area. One-half the individual PAH's quantitation limit was used as a proxy concentration in the sum for those samples in which the individual PAH was reported as undetected.
(a) Only chemicals with at least one positively detected result are reported.
(b) Frequency of detection - Number of detected samples: Number of total samples.
(c) Maximum detected concentration for each chemical, after duplicates have been averaged. If maximum concentration exceed ESL, average and 95% UCL values were develop
(d) Eco-SSL for alumimum is dependent on soil pH. No risk likely if pH > 5.5. Site soil pH is average of 8.4. Toxicity due to aluminum is not expected.
(e) Eco-SSL for iron is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions). Toxicity due to iron is not expected.

Table 4-3
Surface Soil Ecological COPC UCL and Background Evaluation - AOC 22 Exposure Area
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

CAS	Chemical (a)	Units	FOD (b)	Average Concentration	95% UCL	Maximum Detected Concentration (c)	Ecological Screening Value	95%UCL HQ	Does 95%UCL Exceed ESV?	Location of Maximum Detection	Number of Samples Exceeding the ESV	Ecological COPC?
Inorganics												
7440-36-0	Antimony	mg/kg	17:18	1.21E+00	1.55E+00	2.49E+00	0.27	5.8	Yes	AOC22RA8	16 (all J flag)	Yes
7440-43-9	Cadmium	mg/kg	18:18	1.23E+00	1.77E+00	3.31E+00	0.36	4.9	Yes	AOC22RA8	18	Yes
7440-47-3	Chromium (total)	mg/kg	18:18	3.30E+01	4.42E+01	9.20E+01	26	1.7	Yes	AOC22RA16	11	Yes
7440-50-8	Copper	mg/kg	18:18	2.84E+01	3.57E+01	6.55E+01	28	1.3	Yes	AOC22RA8	7	Yes
7439-92-1	Lead	mg/kg	18:18	1.07E+02	1.67E+02	3.41E+02	11	15.2	Yes	AOC22RA5	17	No (Bkgd.)
7439-96-5	Manganese	mg/kg	18:18	1.12E+03	1.54E+03	3.18E+03	500	3.1	Yes	AOC22RA10	13	Yes
7439-97-6	Mercury	mg/kg	17:18	1.73E-01	2.63E-01	5.78E-01	0.30	0.9	No	AOC22RA8	3	No (95%UCL<ESL)
7440-02-0	Nickel	mg/kg	18:18	1.74E+01	2.02E+01	3.35E+01	28	0.7	No	AOC22RA8	1	No (95%UCL<ESL)
7782-49-2	Selenium	mg/kg	14:18	8.30E-01	1.05E+00	2.11E+00	1.0	1.0	No	AOC22RA9	4	No (95%UCL<ESL)
7440-62-2	Vanadium	mg/kg	18:18	1.67E+01	1.95E+01	3.05E+01	7.8	2.5	Yes	AOC22RA4	17	No (Bkgd.)
7440-66-6	Zinc	mg/kg	17:17	3.33E+02	5.20E+02	1.36E+03	50	10.4	Yes	AOC22RA5	17	Yes
SVOCs												
90-12-0	1-Methylnaphthalene	mg/kg	14:17	1.38E-01	2.22E-01	5.45E-01	NE	NE	NE	AOC22RA2	NE	Yes
56-55-3	Benzo(a)anthracene	mg/kg	18:18	7.90E+00	4.62E+01	5.01E+01	5.21	8.9	Yes	AOC22RA11	3	No (Bkgd.)
50-32-8	Benzo(a)pyrene	mg/kg	18:18	5.85E+00	3.36E+01	3.76E+01	1.52	22.1	Yes	AOC22RA11	5	No (Bkgd.)
86-74-8	Carbazole	mg/kg	7:18	1.08E+00	7.20E+00	9.30E+00	NV	NE	NE	AOC22RA2	NE	Yes
218-01-9	Chrysene	mg/kg	18:18	7.20E+00	4.15E+01	4.48E+01	4.73	8.8	Yes	AOC22RA11	3	Yes
132-64-9	Dibenzofuran	mg/kg	4:18	2.30E+00	1.55E+01	2.13E+01	NV	NE	NE	AOC22RA2	NE	Yes
206-44-0	Fluoranthene	mg/kg	18:18	2.02E+01	1.24E+02	1.44E+02	122	1.0	No	AOC22RA2	1	No (95%UCL<ESL)
91-20-3	Naphthalene	mg/kg	18:18	3.71E+00	3.18E+01	5.10E+01	0.0994	320.3	Yes	AOC22RA2	6	Yes
85-01-8	Phenanthrene	mg/kg	18:18	1.71E+01	1.09E+02	1.37E+02	45.7	2.4	Yes	AOC22RA2	2	Yes
129-00-0	Pyrene	mg/kg	18:18	1.49E+01	8.76E+01	9.71E+01	78.5	1.1	Yes	AOC22RA11	2	No (95%UCL<ESL)
Total PAHs	Total PAHs	mg/kg		7.69E+01	4.74E+02	5.62E+02	1.0	473.7	Yes			Yes
VOCs												
79-20-9	Methylacetate	mg/kg	2:18	7.86E-01		1.20E+00	NV	NE	NE	AOC22RA18	NE	No (f)
108-87-2	Methylcyclohexane	mg/kg	1:18	2.66E-01		2.66E-01	NV	NE	NE	AOC22RA18	NE	No (f)
95-47-6	Xylene	mg/kg	1:18	2.65E-01		2.65E-02	NV	NE	NE	AOC22RA18	NE	No (f)
PCBs												
Total PCBs	Total PCBs	mg/kg	18:18	5.93E-01	9.77E-01	2.30E+00	40	0.02	No	AOC22RA8	0	No (g)

Compounds listed are those where maximum detected concentrations exceed ESLs (COPCs) or no ESL exists for that compound.
Compounds in light green highlight are consistent with background (Appendix G). Compounds in purple highlight 95%UCL does not exceed ESL and # of samples >ESL is low.
CAS - Chemical Abstract Service.
ESV - Ecological screening value
HQ - Hazard Quotient (Maximum concentration/ESV)
NV - No value identified
NE - Not evaluated due to lack of screening value
Total PCBs is the sum of Aroclor 1248, Aroclor 1254 and Aroclor 1260.
Xylene is the sum of m,p, and o-isomers.
Total PAHs is the sum of the PAHs detected within this exposure area. One-half the individual PAH's quantitation limit was used as a proxy concentration in the sum for those samples in which the individual PAH was reported as undetected.
(a) Only chemicals with at least one positively detected result are reported.
(b) Frequency of detection - Number of detected samples: Number of total samples.
(c) Maximum detected concentration for each chemical, after duplicates have been averaged. If maximum concentration exceed ESL, average and 95% UCL values were developed.
(d) Eco-SSL for alumimum is dependent on soil pH. No risk likely if pH > 5.5. Site soil pH is average of 8.4. Toxicity due to aluminum is not expected.
(e) Eco-SSL for iron is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions). Toxicity due to iron is not expected.
(f) Compounds are not considered COPCs in AOC22. Low detection frequencies and not significant in site soils (areas of known historical impact/use).

Table 5-1
Surface Soil Ecological Screening Evaluation - AOC 22 Exposure Area
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

CAS	Chemical (a)	Units	FOD (b)	Maximum Detected Concentration (c)	Ecological Screening Value	Maximum HQ	Does Maximum Detection Exceed ESV?	Location of Maximum Detection
Inorganics								
7429-90-5	Aluminum	mg/kg	18:18	1.92E+04	(d)	(d)	(d)	AOC22RA14
7440-36-0	Antimony	mg/kg	17:18	***2.49E+00***	0.27	9.2	Yes	AOC22RA8
7440-38-2	Arsenic	mg/kg	18:18	***1.43E+01***	18	0.8	No	AOC22RA4
7440-39-3	Barium	mg/kg	18:18	2.25E+02	330	0.68	No	AOC22RA14
7440-41-7	Beryllium	mg/kg	18:18	3.48E+00	21	0.17	No	AOC22RA14
7440-43-9	Cadmium	mg/kg	18:18	***3.31E+00***	0.36	9	Yes	AOC22RA8
7440-47-3	Chromium (total)	mg/kg	18:18	***9.20E+01***	26	3.5	Yes	AOC22RA16
7440-48-4	Cobalt	mg/kg	18:18	1.03E+01	13	0.79	No	AOC22RA8
7440-50-8	Copper	mg/kg	18:18	***6.55E+01***	28	2.3	Yes	AOC22RA8
7439-89-6	Iron	mg/kg	18:18	6.92E+04	(e)	(e)	(e)	AOC22RA4
7439-92-1	Lead	mg/kg	18:18	***3.41E+02***	11	31	Yes	AOC22RA5
7439-96-5	Manganese	mg/kg	18:18	***3.18E+03***	500	6.4	Yes	AOC22RA10
7439-97-6	Mercury	mg/kg	17:18	***5.78E-01***	0.30	1.93	Yes	AOC22RA8
7440-02-0	Nickel	mg/kg	18:18	***3.35E+01***	28	1.20	Yes	AOC22RA8
7782-49-2	Selenium	mg/kg	14:18	***2.11E+00***	1.0	2	Yes	AOC22RA9
7440-22-4	Silver	mg/kg	12:18	1.06E+00	4.2	0.25	No	AOC22RA8
7440-28-0	Thallium	mg/kg	18:18	6.11E-01	1.0	0.6	No	AOC22RA2
7440-62-2	Vanadium	mg/kg	18:18	***3.05E+01***	7.8	3.9	Yes	AOC22RA4
7440-66-6	Zinc	mg/kg	17:17	***1.35E+03***	50	27	Yes	AOC22RA5
SVOCs								
92-52-4	1,1-Biphenyl	mg/kg	2:18	4.56E+00	60	0.0760	No	AOC22RA2
90-12-0	1-Methylnaphthalene	mg/kg	14:17	5.45E-01	NV	NE	NE	AOC22RA2
91-57-6	2-Methylnaphthalene	mg/kg	17:18	2.68E+00	3.24	0.83	No	AOC22RA2
83-32-9	Acenaphthene	mg/kg	12:18	2.26E+00	682	0.0033	No	AOC22RA2
208-96-8	Acenaphthylene	mg/kg	18:18	2.35E+01	682	0.0345	No	AOC22RA2
120-12-7	Anthracene	mg/kg	18:18	3.32E+01	1480	0.0224	No	AOC22RA2
56-55-3	Benzo(a)anthracene	mg/kg	18:18	***5.01E+01***	5.21	9.62	Yes	AOC22RA11
50-32-8	Benzo(a)pyrene	mg/kg	18:18	***3.75E+01***	1.52	24.7	Yes	AOC22RA11
205-99-2	Benzo(b)fluoranthene	mg/kg	18:18	4.06E+01	59.8	0.68	No	AOC22RA2
191-24-2	Benzo(g,h,i)perylene	mg/kg	18:18	1.81E+01	119	0.152	No	AOC22RA11
207-08-9	Benzo(k)fluoranthene	mg/kg	18:18	3.81E+01	148	0.257	No	AOC22RA11
86-74-8	Carbazole	mg/kg	7:18	9.30E+00	NV	NE	NE	AOC22RA2
218-01-9	Chrysene	mg/kg	18:18	***4.49E+01***	4.73	9.5	Yes	AOC22RA11
53-70-3	Dibenz(a,h)anthracene	mg/kg	18:18	5.63E+00	18.4	0.306	No	AOC22RA11
132-64-9	Dibenzofuran	mg/kg	4:18	2.13E+01	NV	NE	NE	AOC22RA2
206-44-0	Fluoranthene	mg/kg	18:18	***1.44E+02***	122	1.180	Yes	AOC22RA2
86-73-7	Fluorene	mg/kg	17:18	3.31E+01	122	0.2713	No	AOC22RA2
193-39-5	Indeno(1,2,3-cd)pyrene	mg/kg	18:18	1.71E+01	109	0.157	No	AOC22RA11
91-20-3	Naphthalene	mg/kg	18:18	***5.10E+01***	0.0994	513.1	Yes	AOC22RA2
85-01-8	Phenanthrene	mg/kg	18:18	***1.37E+02***	45.7	2.998	Yes	AOC22RA2
129-00-0	Pyrene	mg/kg	18:18	***9.71E+01***	78.5	1.237	Yes	AOC22RA11
Total PAHs	Total PAHs	mg/kg		***5.62E+02***	1.0	562.0	Yes	
VOCs								
67-64-1	Acetone	mg/kg	2:18	3.60E-02	2.5	0.014	No	AOC22RA1
110-82-7	Cyclohexane	mg/kg	1:18	7.30E-02	0.1	0.73	No	AOC22RA18
79-20-9	Methylacetate	mg/kg	2:18	1.20E+00	NV	NE	NE	AOC22RA18
108-87-2	Methylcyclohexane	mg/kg	1:18	2.66E-01	NV	NE	NE	AOC22RA18
108-88-3	Toluene	mg/kg	1:18	1.03E-01	5.45E+00	0.019	No	AOC22RA18
95-47-6	Xylene	mg/kg	1:18	2.65E-02	NV	NE	NE	AOC22RA18
PCBs								
Total PCBs	Total PCBs	mg/kg	18:18	2.37E+00	40	0.059	No	AOC22RA8

Concentrations in boldface italics exceed the ESV. Compounds in light green highlight are consistent with background (Appendix F).
CAS - Chemical Abstract Service.
ESV - Ecological screening value
HQ - Hazard Quotient (Maximum concentration/ESV)
NV - No value identified
NE - Not evaluated due to lack of screening value
Total PCBs is the sum of Aroclor 1248, Aroclor 1254 and Aroclor 1260.
Xylene is the sum of m,p, and o-isomers.
Total PAHs is the sum of the PAHs detected within this exposure area. One-half the individual PAH's quantitation limit was used as a proxy concentration in the sum for those samples in which the individual PAH was reported as undetected.
(a) Only chemicals with at least one positively detected result are reported.
(b) Frequency of detection - Number of detected samples: Number of total samples.
(c) Maximum detected concentration for each chemical, after duplicates have been averaged. If maximum concentration exceed ESL, average and 95% UCL values were develop
(d) Eco-SSL for aluminum is dependent on soil pH. No risk likely if pH > 5.5. Site soil pH is average of 8.4. Toxicity due to aluminum is not expected.
(e) Eco-SSL for iron is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions). Toxicity due to iron is not expected.

Table 5-2
Surface Soil Ecological COPC UCL and Background Evaluation - AOC 22 Exposure Area
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

CAS	Chemical (a)	Units	FOD (b)	Average Concentration	95% UCL	Maximum Detected Concentration (c)	Ecological Screening Value	95%UCL HQ	Does 95%UCL Exceed ESV?	Location of Maximum Detection	Number of Samples Exceeding the ESV	Ecological COPC?
Inorganics												
7440-36-0	Antimony	mg/kg	17:18	1.21E+00	1.55E+00	2.49E+00	0.27	5.8	Yes	AOC22RA8	16 (all J flag)	Yes
7440-43-9	Cadmium	mg/kg	18:18	1.23E+00	1.77E+00	3.31E+00	0.36	4.9	Yes	AOC22RA8	18	Yes
7440-47-3	Chromium (total)	mg/kg	18:18	3.30E+01	4.42E+01	9.20E+01	26	1.7	Yes	AOC22RA16	11	Yes
7440-50-8	Copper	mg/kg	18:18	2.84E+01	3.57E+01	6.55E+01	28	1.3	Yes	AOC22RA8	7	Yes
7439-92-1	Lead	mg/kg	18:18	1.07E+02	1.67E+02	3.41E+02	11	15.2	Yes	AOC22RA5	17	No (Bkgd.)
7439-96-5	Manganese	mg/kg	18:18	1.12E+03	1.54E+03	3.18E+03	500	3.1	Yes	AOC22RA10	13	Yes
7439-97-6	Mercury	mg/kg	17:18	1.73E-01	2.63E-01	5.78E-01	0.30	0.9	No	AOC22RA8	3	No (Bkgd)
7440-02-0	Nickel	mg/kg	18:18	1.74E+01	2.02E+01	3.35E+01	28	0.7	No	AOC22RA8	1	No (95%UCL<ESL)
7782-49-2	Selenium	mg/kg	14:18	8.30E-01	1.05E+00	2.11E+00	1.0	1.0	No	AOC22RA9	4	No (95%UCL<ESL)
7440-62-2	Vanadium	mg/kg	18:18	1.67E+01	1.95E+01	3.05E+01	7.8	2.5	Yes	AOC22RA4	17	No (Bkgd.)
7440-66-6	Zinc	mg/kg	17:17	3.33E+02	5.20E+02	1.36E+03	50	10.4	Yes	AOC22RA5	17	Yes
SVOCs												
90-12-0	1-Methylnaphthalene	mg/kg	14:17	1.38E-01	2.22E-01	5.45E-01	NE	NE	NE	AOC22RA2	NE	Yes
56-55-3	Benzo(a)anthracene	mg/kg	18:18	7.90E+00	4.62E+01	5.01E+01	5.21	8.9	Yes	AOC22RA11	3	No (Bkgd.)
50-32-8	Benzo(a)pyrene	mg/kg	18:18	5.85E+00	3.36E+01	3.76E+01	1.52	22.1	Yes	AOC22RA11	5	No (Bkgd.)
86-74-8	Carbazole	mg/kg	7:18	1.08E+00	7.20E+00	9.30E+00	NV	NE	NE	AOC22RA2	NE	Yes
218-01-9	Chrysene	mg/kg	18:18	7.20E+00	4.15E+01	4.48E+01	4.73	8.8	Yes	AOC22RA11	3	Yes
132-64-9	Dibenzofuran	mg/kg	4:18	2.30E+00	1.55E+01	2.13E+01	NV	NE	NE	AOC22RA2	NE	Yes
206-44-0	Fluoranthene	mg/kg	18:18	2.02E+01	1.24E+02	1.44E+02	122	1.0	No	AOC22RA2	1	No (95%UCL<ESL)
91-20-3	Naphthalene	mg/kg	18:18	3.71E+00	3.18E+01	5.10E+01	0.0994	320.3	Yes	AOC22RA2	6	Yes
85-01-8	Phenanthrene	mg/kg	18:18	1.71E+01	1.09E+02	1.37E+02	45.7	2.4	Yes	AOC22RA2	2	Yes
129-00-0	Pyrene	mg/kg	18:18	1.49E+01	8.76E+01	9.71E+01	78.5	1.1	Yes	AOC22RA11	2	No (95%UCL<ESL)
Total PAHs	Total PAHs	mg/kg		7.69E+01	4.74E+02	5.62E+02	1.0	473.7	Yes			Yes
VOCs												
79-20-9	Methylacetate	mg/kg	2:18	7.86E-01		1.20E+00	NV	NE	NE	AOC22RA18	NE	No (f)
108-87-2	Methylcyclohexane	mg/kg	1:18	2.66E-01		2.66E-01	NV	NE	NE	AOC22RA18	NE	No (f)
95-47-6	Xylene	mg/kg	1:18	2.65E-01		2.65E-02	NV	NE	NE	AOC22RA18	NE	No (f)
PCBs												
Total PCBs	Total PCBs	mg/kg	18:18	5.93E-01	9.77E-01	2.30E+00	40	0.02	No	AOC22RA8	0	No (g)

Compounds listed are those where maximum detected concentrations exceed ESLs (COPCs) or no ESL exists for that compound.
Compounds in light green highlight are consistent with background (Appendix F). Compounds in purple highlight 95%UCL does not exceed ESL and # of samples >ESL is low.
CAS - Chemical Abstract Service.
ESV - Ecological screening value
HQ - Hazard Quotient (Maximum concentration/ESV)
NV - No value identified
NE - Not evaluated due to lack of screening value
Total PCBs is the sum of Aroclor 1248, Aroclor 1254 and Aroclor 1260.
Xylene is the sum of m,p, and o-isomers.
Total PAHs is the sum of the PAHs detected within this exposure area. One-half the individual PAH's quantitation limit was used as a proxy concentration in the sum for those samples in which the individual PAH was reported as undetected.
(a) Only chemicals with at least one positively detected result are reported.
(b) Frequency of detection - Number of detected samples: Number of total samples.
(c) Maximum detected concentration for each chemical, after duplicates have been averaged. If maximum concentration exceed ESL, average and 95% UCL values were developed.
(d) Eco-SSL for alumimum is dependent on soil pH. No risk likely if pH > 5.5. Site soil pH is average of 8.4. Toxicity due to aluminum is not expected.
(e) Eco-SSL for iron is dependent on site-specific soil conditions (e.g. pH, Eh, soil-water conditions). Toxicity due to iron is not expected.
(f) Compounds are not considered COPCs in AOC22. Low detection frequencies and not significant in site soils (areas of known historical impact/use).
(g)

Table 6-1
Comparison of Great Miami River Sediment Concentrations Against Ohio Sediment Reference Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Chemical Retained in Sediment	Units	Maximum Detected Concentration (a)	Ohio Sediment Reference Value (b)	Does Maximum Concentration Detected Exceed SRV?
Inorganics				
Aluminum	mg/kg	18100	39000	No
Arsenic	mg/kg	10.6	18.0	No
Barium	mg/kg	***523***	240	Yes
Cadmium	mg/kg	***1.8***	0.90	Yes
Chromium (total)	mg/kg	***63.3***	40.0	Yes
Copper	mg/kg	***163***	34.0	Yes
Iron	mg/kg	***37900***	33000	Yes
Lead	mg/kg	***2980***	47.0	Yes
Manganese	mg/kg	***2370***	780	Yes
Mercury	mg/kg	***0.19***	0.12	No
Nickel	mg/kg	31.5	42.0	No
Vanadium	mg/kg	39.4	40.0	No
Zinc	mg/kg	***681***	160	Yes

Concentrations in boldface italics exceed the SRV.
SRV - Sediment reference value
NV - No value identified
NE - Not evaluated due to lack of screening value

(a) Maximum detected concentration for each chemical, after duplicates have been averaged.
(b) SRVs presented are established for the Eastern Corn Belt Plains eco-region with the exception of the statewide values for lead, mercury, and vanadium.

Table 6-2
AVS/SEM in Sediment of the Great Miami River
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Upstream of Site

Analyte	GMRSD30 09/26/2007	GMRSD34 09/26/2007	GMRSD29 09/26/2007	GMRSD33 09/26/2007	GMRSD28 09/26/2007
SEM and AVS (umol/g)					
Acid Volatile Sulfide	0.143 U	0.136 U	0.143	0.121 U	10.6
Cadmium	0.00694 J-	0.000598 UJ	0.000578 UJ	0.000525 UJ	0.00374 J-
Copper	0.51 J	0.0378 J	0.0283 J	0.0135 J	0.312 J
Lead	0.111 J	0.0121 J	0.0121 J	0.00531 J	0.132 J
Nickel	0.121	0.0221	0.0148	0.0134	0.143
Zinc	2.62 J	0.138 J	0.107 J	0.0627 J	1.44 J
Total Organic Carbon (mg/kg)	19600	32900	12600	4620	42900
[Sum SEM - AVS] (umol/g)	3.2	0.675	0.020	-0.026	-8.6
[Sum SEM - AVS]/f_{oc} (umol/g_{oc})	*165*	2.3	1.6	-5.5	-199.7

Adjacent to Site

Analyte	GMRSD27 GMRSD27AA 09/26/2007	GMRSD26 GMRSD26AA 09/26/2007	GMRSD3 GMRSD1AASEM 11/09/2005	GMRSD25 GMRSD25AA 09/26/2007	GMRSD32 GMRSD32AA 09/26/2007	GMRSD31 GMRSD31AA 09/26/2007	GMRSD31 dup GMRSD31AB 09/26/2007	GMRSD24 GMRSD24AA 09/25/2007
SEM and AVS (umol/g)								
Acid Volatile Sulfide	1.72	3.06	2.39	1.82	2.16	2.1	2.59	0.732
Cadmium	0.000578 UJ	0.000632 U	0.00142 J-	0.000601 J-	0.00056 UJ	0.000601 J-	0.000534 UJ	0.00116 J-
Copper	0.0393 J	0.0692 J	0.106	0.0582 J	0.0252 J	0.0315 J	0.0157 J	0.0682 J
Lead	0.0164 J	0.0333 J	0.0336 J-	0.0217 J	0.0116 J	0.0125 J	0.0082 J	0.0106 J
Nickel	0.0256	0.0221	0.0579 J-	0.0221	0.0133	0.0187	0.0121	0.0141
Zinc	0.141 J	0.269 J	0.367 J	0.205 J	0.116 J	0.162 J	0.0867 J	0.525 J
Total Organic Carbon (mg/kg)	10800	13500	19200 J	25600	5810	10300	10300	1720
Sum SEM (umol/g)	0.2	0.4	0.6	0.3	0.2	0.2	0.1	0.6
[Sum SEM - AVS] (umol/g)	-1.5	-2.7	-1.8	-1.5	-2.0	-1.9	-2.5	-0.12
[Sum SEM - AVS]/f_{oc} (umol/g_{oc})	-139	-197	-94.0	-59.3	-343	-180	-238	-71.5

Analyte	GMRSD22 GMRSD22AA 09/25/2007	GMRSD21 GMRSD21AA 09/25/2007	GMRSD6 GMRSD6AASEM 11/09/2005	GMRSD20 GMRSD20AA 09/25/2007	GMRSD20 dup GMRSD20AB 09/25/2007	GMRSD8 GMRSD8AASEM 11/09/2005
SEM and AVS (umol/g)						
Acid Volatile Sulfide	0.12 U	1.03	6.96	2.12	2.07	6.61
Cadmium	0.000525 UJ	0.000543 J	0.00596 J-	0.000978 J-	0.00133 J-	0.000712 J-
Copper	0.0134 J	0.0262 J	0.252	0.085 J	0.107 J	0.0582
Lead	0.00579 J	0.00772 J	0.097 J-	0.028 J	0.0405 J	0.0222 J-
Nickel	0.0092	0.0145	0.0988 J-	0.0409	0.046	0.0426 J-
Zinc	0.052 J	0.19 J	1.4 J-	0.317 J	0.429 J	0.216 J
Total Organic Carbon (mg/kg)	10100	8550	14100 J	11700	11700	12300 J
Sum SEM (umol/g)	0.1	0.2	1.9	0.5	0.6	0.3
[Sum SEM - AVS] (umol/g)	-0.039	-0.79	-5.1	-1.6	-1.4	-6.3
[Sum SEM - AVS]/f_{oc} (umol/g_{oc})	-3.9	-92.6	-362	-141	-124	-510

Downstream of Site

Analyte	GMRSD23 GMRSD23AA 09/25/2007
SEM and AVS (umol/g)	
Acid Volatile Sulfide	1.69 U
Cadmium	0.00089 J-
Copper	0.0771 J
Lead	0.0246 J
Nickel	0.0324
Zinc	0.266 J
Total Organic Carbon (mg/kg)	16400
Sum SEM (umol/g)	0.4
[Sum SEM - AVS] (umol/g)	-1.5
[Sum SEM - AVS]/f_{oc} (umol/g_{oc})	-90.8

Notes:
AVS - Acid Volatile Sulfides
NC - Not Calculated
SEM - Simultaneously Extracted Metals
TOC - Total Organic Carbon
f_{oc} - fraction organic carbon
g_{oc} - gram organic carbon

U - Not detected; Detection limit presented. Full detection limit used in calculation.
J - Estimated value.
TOC value for duplicates taken from parent sample.

Bold text indicates SEM - AVS > 0.
Italic bold text indicates [Sum SEM-AVS]/f_{oc} > 130 umol/g_{oc} (below this value the sediments are presumed to "not likely" be toxic (U.S. EPA, 2005)).
According to U.S. EPA guidance (2005):
[Sum SEM-AVS]/f_{oc} > 3000 umol/g_{oc}, the sediments are presumed to be "likely to be toxic";
[Sum SEM-AVS]/f_{oc} between 130 and 3,000 umol/g_{oc}, predictions of effects are uncertain; and
[Sum SEM-AVS]/f_{oc} < 130 umol/g_{oc}, the sediments are presumed to "not likely" be toxic.

Table 6-3
AOC 22 Exposure Area COC Comparison to Effects Levels
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

CAS	Chemical (a)	FOD (b)	Average Concentration	95% UCL	Maximum Detected Concentration (c)	Ecological Screening Value Used in SLERA	95%UCL HQ	EcoSSL Mammalian / HQ	Eco-SSL or ORNL* Inverts / HQ	EcoSSL Earthworms /HQ	Location of Maximum Detection	Number of Samples Exceeding the ESV
Inorganics												
7440-36-0	Antimony	17:18	1.21E+00	1.55E+00	2.49E+00	0.27	5.8	0.27 / 5.7	78 / 0.02	NV	AOC22RA8	16 (all J flag)
7440-43-9	Cadmium	18:18	1.23E+00	1.77E+00	3.31E+00	0.36	4.9	.36 / 4.9	140 / 0.02	110 / 0.02	AOC22RA8	18
7440-47-3	Chromium (total)	18:18	3.30E+01	4.42E+01	9.20E+01	26	1.7	34 / 1.3	NV	0.4 / 111	AOC22RA16	11
7440-50-8	Copper	18:18	2.84E+01	3.57E+01	6.55E+01	28	1.3	51 / 0.7	80 / 0.45	61 / 0.59	AOC22RA8	7
7439-96-5	Manganese	18:18	1.12E+03	1.54E+03	3.18E+03	500	3.1	NV	NV	NV	AOC22RA10	13
7440-66-6	Zinc	17:17	3.33E+02	5.20E+02	1.36E+03	50	10.4	NV	100* / 5.2	120 / 4.3	AOC22RA5	17
SVOCs												
90-12-0	1-Methylnaphthalene	14:17	1.38E-01	2.22E-01	5.45E-01	NE	NE	NV	NV	NV	AOC22RA2	NE
91-20-3	Naphthalene	18:18	3.71E+00	3.18E+01	5.10E+01	0.0994	320.3	NV	NV	NV	AOC22RA2	6
85-01-8	Phenanthrene	18:18	1.71E+01	1.09E+02	1.37E+02	45.7	2.4	NV	NV	NV	AOC22RA2	2
Total PAHs	Total PAHs		7.69E+01	4.74E+02	5.62E+02	1.0	474.0	NV	NV	NV		
PCBs												
Total PCBs	Total PCBs	18:18	5.93E-01	9.77E-01	2.30E+00	40	0.02	NV	NV	NV	AOC22RA8	0

All units are in mg/kg.
Compounds listed are those where HQ was greater than 1 and compounds were not consistent with site background.
Compounds in light green highlight have a Hazard Quotient (HQ) less than 1.
CAS - Chemical Abstract Service.
ESV - Ecological screening value
HQ - Hazard Quotient (Maximum concentration/ESV)
NV - No value identified
NE - Not evaluated due to lack of screening value
Total PCBs is the sum of Aroclor 1248, Aroclor 1254 and Aroclor 1260.
Total PAHs is the sum of the PAHs detected within this exposure area. One-half the individual PAH's quantitation limit was used as a proxy concentration in the sum for those samples in which the individual PAH was reported as undetected.
(a) Only chemicals with at least one positively detected result are reported.
(b) Frequency of detection - Number of detected samples: Number of total samples.
(c) Maximum detected concentration for each chemical, after duplicates have been averaged. If maximum concentration exceed ESL, average and 95% UCL values were developed.

Table 11-1
Comparison of Great Miami River Sediment Concentrations Against Ohio Sediment Reference Values
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Chemical Retained in Sediment	Units	Maximum Detected Concentration (a)	Ohio Sediment Reference Value (b)	Does Maximum Concentration Detected Exceed SRV?
Inorganics				
Aluminum	mg/kg	18100	39000	No
Arsenic	mg/kg	10.6	18.0	No
Barium	mg/kg	***523***	240	Yes
Cadmium	mg/kg	***1.8***	0.90	Yes
Chromium (total)	mg/kg	***63.3***	40.0	Yes
Copper	mg/kg	***163***	34.0	Yes
Cyanide	mg/kg	8.86	NV	NE
Iron	mg/kg	***37900***	33000	Yes
Lead	mg/kg	***2980***	47.0	Yes
Manganese	mg/kg	***2370***	780	Yes
Mercury	mg/kg	***0.19***	0.12	No
Nickel	mg/kg	31.5	42.0	No
Vanadium	mg/kg	39.4	40.0	No
Zinc	mg/kg	***681***	160	Yes

Concentrations in boldface italics exceed the SRV.
SRV - Sediment reference value
NV - No value identified
NE - Not evaluated due to lack of screening value

(a) Maximum detected concentration for each chemical, after duplicates have been averaged.
(b) SRVs presented are established for the Eastern Corn Belt Plains eco-region with the exception of the statewide values for lead, mercury, and vanadium.

APPENDIX A
SEDIMENT SAMPLING RESULTS OF THE GREAT MIAMI RIVER, 2007

Table 3-1
Surficial Sediment Ecological Screening Evaluation
Evaluation of Bulk Sediment Analytical Chemistry Data
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

	Ecological Screening Value		Upstream							Adjacent to Site						
			GMRSD19	GMRSD30	GMRSD34	GMRSD29	GMRSD33	GMRSD28	GMRSD15	GMRSD14	GMRSD27	GMRSD9	GMRSD26	GMRSD4	GMRSD7	GMRSD3
Analyte	Low Effect	Probable Effect	11/11/2005	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/10/2005	11/10/2005	09/26/2007	11/10/2005	09/26/2007	11/09/2005	11/09/2005	11/09/2005
Inorganics (mg/kg)																
Aluminum	25500 [5]	NV	22200	10500	5830	3280	1530	11600	2330	12500	2900	18100	6850	5870	11100	5570
Arsenic	9.79 [1]	33 [1]	**15.4**	8.5 J+	3.7 J+	3.1 J+	2.1 J+	6.6 J+	1.7	9.1	2.5 J+	**10.6**	8 J+	4.3	5.8	3.7
Barium	0.7 [5,6]	NV	**446** J	**142** J	**92.3** J	**49.4** J	**17.9** J	**212** J	**13.9** J	**93.1** J	**36.6** J	**149** J	**94.6** J	**73.7** J	**112** J	**56.2** J
Beryllium	NV	NV	1 U	0.74	0.66 U	0.69 U	0.58 U	3.3 U	0.59 U	0.66 U	0.72 U	0.84 U	0.89	0.81 U	0.78 U	0.73 U
Cadmium	0.99 [1]	4.98 [1]	**4.9**	**1.7**	0.66 U	0.69 U	0.58 U	3.3 U	0.59 U	0.66 U	0.72 U	**1.1** J+	0.77 U	0.81 U	0.78 U	0.73 U
Calcium	EN	EN	46400	78100	93400	107000	149000	109000	90900	88000	95200	63100	101000	95800	100000	101000
Chromium (total)	43.4 [1]	111 [1]	*224* J	**74.4** J	12.7 J	9 J	5.2 J	25 J	7.1 J	26.8 J	7.9 J	**63.3** J	17.4 J	14.9 J	19.7 J	12.6 J
Cobalt	50 [3]	NV	11.9	6.8 U	6.6 U	6.9 U	5.8 U	32.8 U	5.9 U	10.6	7.2 U	9.2	7.7 U	8.1 U	7.8 U	7.3 U
Copper	31.6 [1]	149 [1]	*275*	**88.9** J+	18.2 J+	10.7 J+	3 J+	**33.1** J+	6.9	**38.5**	8.5 J+	**66.2**	**116** J+	17.6	26.2	14.9
Cyanide	0.1 [3]	NV	2 U						1.25 U	1.36 U		1.77 U		1.68 U	1.6 U	1.48 U
Iron	20000 [2]	40000 [2]	*57700*	**28900**	11000	11700	5210	**20500**	13400	**31200**	8660	**34700**	**37900**	17600	**22700**	13800
Lead	35.8 [1]	128 [1]	*224*	**58.7**	14	9.8	3	**42.5**	4.2	18.9	8.1	**54.2**	*2980*	18.3	22.7	12.6
Magnesium	EN	EN	13700 J	29900 J	21700 J	21300 J	28800 J	17200 J	27600 J	27100 J	24900 J	21000 J	16100 J	26600 J	27200 J	28100 J
Manganese	460 [2]	1100 [2]	**488** J	231	327	307	184	**721**	217 J	**564** J	223	434 J	**544**	326 J	**502** J	295 J
Mercury	0.18 [1]	1.06 [1]	**0.63**	**0.28**	0.04 U	0.04 U	0.04 U	0.23 U	0.04 U	0.05	0.05 U	0.16	0.17	0.06 U	0.05	0.05 U
Nickel	22.7 [1]	48.6 [1]	*73.7*	**29.7**	11.4	7.4	4.7 U	26.2 U	6.3	**27.9**	7.1	**31.5**	**22.8**	10.9	16.8	9.7
Potassium	EN	EN	2580	1660	1250	795	304	2740	373	2370	597	2820	876	1050	1860	1030
Selenium	2 [4]	NV	2 U	**2.3**	1.5	1.4 U	1.2 U	6.6 U	1.2 U	1.3 U	1.4 U	1.7	**2.8**	1.7	1.6 U	1.5 U
Sodium	EN	EN	184	219	239	250	175	810	156	166	182	179	479	207	199	191
Thallium	NV	NV	10 U	1.4 U	1.5	1.4	2	6.6 U	5.9 U	6.6 U	1.4 U	8.4 U	2	8.1 U	7.8 U	7.3 U
Vanadium	50 [5,6]	NV	44.1	25.9	12.8	10.9	6.1	32.8 U	12.9	26.6	9.6	39.4	11.2	17.3	25.4	16.9
Zinc	121 [1]	459 [1]	*686* J	**422** J	65.1 J	32.6 J	11.4 J	**145** J	19.4 J	70.2 J	29.1 J	**210** J	107 J	61 J	96.8 J	59.6 J
SVOCs (ug/kg)																
Total PAHs (ND=0)	1.6 [1]	22800 [1]	**14250**	**2931**	**2109**	**14371**	**49**	**5250**	**444.7**	**6033**	**2220**	**10005**	**11102**	**6090**	**13814**	**4495**
Total PAHs (ND=DL)	1.6 [1]	22800 [1]	**19050**	**4341**	**6509**	**14831**	**5649**	*32250*	**544.7**	**6373**	**4100**	**10005**	**11102**	**6240**	**14014**	**4915**
PCBs (ug/kg)																
Total PCBs (ND=0)	0.0598 [1]	676 [1]	0	**191**	**141**	**155**	**89**	**250**	**230**	0	**211**	**122**	**280**	**240**	**140**	**220**
Total PCBs (ND=DL)	0.0598 [1]	676 [1]	**264**	**285**	**229**	**247**	**169**	*910*	**353**	**180**	**305**	**238**	**384**	**405**	**299**	**367**

Notes
EN - Essential Nutrient
ESL - Ecological Screening Level
LEL - Lowest Effect Level
SEL - Severe Effect Level
NV - Screening value not identified
PAH - Polycyclic Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyl
TEC - Threshold Effect Concentration
PEC - Probable Effect Concentration
TOC - Total Organic Carbon

U - Not detected. Detection limit presented.
J - Estimated value.

(ND = 0) - Non-detects not included in sum for Total PAHs or Total PCBs
(ND = DL) - Full detection limit value used as surrogate for non-detect compounds in sum for Total PAHs or Total PCBs
Only analytes detected at least once are presented.
Only detected concentrations are compared to ecological screening values.
Blanks indicate that analyte was not analyzed for.
Bold text indicates value exceeds Low Effect screening value.
Shading indicates value exceeds both Low Effect and Probable Effect screening values.

Screening value sources and notes
[1] TEC and PECs from MacDonald, et al. (2000).
[2] LEL and SELs from Ontario Ministry of the Environment (Persaud, et al. 1993).
[3] Region 5 ESLs (U.S. EPA 2003; Available at http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf).
[4] Region 3 Ecological Screening Values (U.S. EPA, 2006; Available at http://www.epa.gov/reg3hwmd/risk/eco/index.htm).
[5] Value from NOAA's Screening Quick Reference Table (Buchman, 1999).
[6] Value is based on background data, not toxicity.

Table 3-1
Surficial Sediment Ecological Screening Evaluation
Evaluation of Bulk Sediment Analytical Chemistry Data
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

	Ecological Screening Value		Adjacent to Site														Downstream
			GMRSD25	GMRSD32	GMRSD6	GMRSD31	GMRSD31 dup	GMRSD24	GMRSD22	GMRSD2	GMRSD21	GMRSD5	GMRSD20	GMRSD20 dup	GMRSD1	GMRSD8	GMRSD23
Analyte	Low Effect	Probable Effect	09/26/2007	09/26/2007	11/09/2005	09/26/2007	09/26/2007	09/25/2007	09/25/2007	11/09/2005	09/25/2007	11/09/2005	09/25/2007	09/25/2007	11/08/2005	11/08/2005	09/25/2007
Inorganics (mg/kg)																	
Aluminum	25500 [5]	NV	10800	11900	6240	3700	3680	3920	2790	2460	3090	9600	3540	4020	5680	2700	3510
Arsenic	9.79 [1]	33 [1]	4.5 J+	4.4 J+	2.5	3 J+	6.7 J+	4.1 J+	2.2 J+	1.3	2.4 J+	4.6	1.4 J+	2.2 J+	2.9	1.9	2.2 J+
Barium	0.7 [5,6]	NV	**140** J	**167**	**77.4** J	**56.5** J	**39.8** J	**49.3** J	**25.1** J	**13.5** J	**20.2** J	**523** J	**57** J	**66.9** J	**99.1** J	**26.6** J	**43.1** J
Beryllium	NV	NV	1.4	3	0.7 U	31	0.63	0.76	0.59 U	0.6 U	0.58 U	0.7 U	0.68 U	0.76 U	0.69 U	0.69 U	0.69 U
Cadmium	0.99 [1]	4.98 [1]	1.2 U	0.61 U	**1.2**	0.58 U	0.58 U	0.59 U	0.59 U	0.6 U	0.58 U	**1.8**	0.68 U	0.76 U	0.76	0.69 U	0.69 U
Calcium	EN	EN	189000	207000	95100	190000	167000	171000	124000	182000	151000	111000	76400	91700	83200	93600	92600
Chromium (total)	43.4 [1]	111 [1]	15.3 J	12 J	21.6 J	6.5 J	7 J	8.9 J	6.6 J	5.9 J	4.3 J	37.8 J	8 J	8.4 J	34.8 J	6.7 J	7.5 J
Cobalt	50 [3]	NV	12.3 U	6.1 U	7 U	5.8 U	5.8 U	5.9 U	5.9 U	6 U	5.8 U	7 U	6.8 U	7.6 U	6.9 U	6.9 U	6.9 U
Copper	31.6 [1]	149 [1]	21.2 J+	9.5 J+	24.7	6.5 J+	7.4 J+	4.7 J+	6.1 J+	4.8	6.8 J+	***163***	13.5 J+	11.4 J+	21.9	7	9.2 J+
Cyanide	0.1 [3]	NV			1.39 U					1.19 U		1.39 U			**8.86**	1.38 U	
Iron	20000 [2]	40000 [2]	14800	7530	14100	8760	9770	17100	7620	7980	10000	**23700**	6910	7980	12700	6800	6920
Lead	35.8 [1]	128 [1]	18	8.3	31.3	9.1	8.5	6.2	4.9	3.8	3.3	***372***	8.3	10.3	***224***	5.8	7
Magnesium	EN	EN	50600 J	54300 J	24600 J	45200 J	37700 J	53800 J	31700 J	36700 J	43200 J	20200 J	17800 J	18000 J	24300 J	26300 J	30300 J
Manganese	460 [2]	1100 [2]	**733**	***2370***	301 J	411	391	449	238	259 J	333	349 J	228	258	285 J	191 J	218
Mercury	0.18 [1]	1.06 [1]	0.08 U	0.04 U	**0.19**	0.04	0.04	0.04 U	0.04 U	0.04 U	0.04 U	0.12	0.05 U	0.05 U	0.06	0.04 U	0.05 U
Nickel	22.7 [1]	48.6 [1]	11.8	4.9 U	12.5	5.9	7.4	6.2	5.4	5	5.1	19.9	6.9	8.2	10.9	5.7	6.6
Potassium	EN	EN	1680	2250	881	496	597	482	562	361	332	1020	739	895	933	552	668
Selenium	2 [4]	NV	**3**	1.6	1.8	1.2 U	1.3	1.2 U	1.2 U	1.2 U	1.4	1.4 U	1.5	1.5 U	1.4 U	1.4 U	1.4 U
Sodium	EN	EN	685	849	221	247	269	274	195	181	223	318	203	226	185	167	194
Thallium	NV	NV	3.3	7.8	7 U	3	3.2	3.9	1.9	6 U	3.5	7 U	1.4 U	1.5 U	6.9 U	6.9 U	1.4 U
Vanadium	50 [5,6]	NV	16.3	7.3	14.3	7.6	8.8	9.3	9.4	8.3	14.5	17.9	11.1	9.5	15.1	8.3	9.8
Zinc	121 [1]	459 [1]	72.2 J	23 J	107 J	24.4 J	26.3 J	21.9 J	19.6 J	16.8 J	15.6 J	***681*** J	38.3 J	41.6 J	**151** J	25.3 J	35.4 J
SVOCs (ug/kg)																	
Total PAHs (ND=0)	1.6 [1]	22800 [1]	**9672**	**2405**	***2465000***	***132080***	***128810***	**3426**	**1578**	**228**	**2139**	**1411**	**2120**	**3340**	**2548**	**1382**	**1123**
Total PAHs (ND=DL)	1.6 [1]	22800 [1]	**11312**	**3205**	***2465000***	***132080***	***128810***	**3816**	**3138**	**627**	**3699**	**1591**	**10520**	**9340**	**3808**	**1646**	**9523**
PCBs (ug/kg)																	
Total PCBs (ND=0)	0.0598 [1]	676 [1]	**250**	**147**	***2240***	**380**	**259**	**132**	**77**	**95**	**53**	**465**	**125**	**156**	**606**	**280**	**54**
Total PCBs (ND=DL)	0.0598 [1]	676 [1]	**414**	**227**	***2700***	**458**	**337**	**210**	**155**	**212**	**131**	**557**	**217**	**260**	**652**	**418**	**192**

Notes
EN - Essential Nutrient
ESL - Ecological Screening Level
LEL - Lowest Effect Level
SEL - Severe Effect Level
NV - Screening value not identified
PAH - Polycyclic Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyl
TEC - Threshold Effect Concentration
PEC - Probable Effect Concentration
TOC - Total Organic Carbon

U - Not detected. Detection limit presented.
J - Estimated value.

(ND = 0) - Non-detects not included in sum for Total PAHs or Total PCBs
(ND = DL) - Full detection limit value used as surrogate for non-detect compounds in sum for Total PAHs or Total PCBs
Only analytes detected at least once are presented.
Only detected concentrations are compared to ecological screening values.
Blanks indicate that analyte was not analyzed for.
Bold text indicates value exceeds Low Effect screening value.
Shading indicates value exceeds both Low Effect and Probable Effect screening values.

Screening value sources and notes
[1] TEC and PECs from MacDonald, et al. (2000).
[2] LEL and SELs from Ontario Ministry of the Environment (Persaud, et al. 1993).
[3] Region 5 ESLs (U.S. EPA 2003; Available at http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf).
[4] Region 3 Ecological Screening Values (U.S. EPA, 2006; Available at http://www.epa.gov/reg3hwmd/risk/eco/index.htm).
[5] Value from NOAA's Screening Quick Reference Table (Buchman, 1999).
[6] Value is based on background data, not toxicity.

Appendix A Surficial Sediment Analytical Data - Metals, TOC, and Solids
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

			sys_loc_code:	GMRSD1	GMRSD14	GMRSD15	GMRSD16	GMRSD16	GMRSD17	GMRSD18	GMRSD19	GMRSD2	GMRSD20	GMRSD20	GMRSD21	GMRSD22	GMRSD23	GMRSD24	GMRSD25	GMRSD26	GMRSD27	GMRSD28	GMRSD29	GMRSD3	GMRSD30
			sys_sample_code:	GMRSD1AA	GMRSD14AA	GMRSD15AA	GMRSD16AA	GMRSD16AB	GMRSD17AA	GMRSD18AA	GMRSD19AA	GMRSD2AA	GMRSD20AA	GMRSD20AB	GMRSD21AA	GMRSD22AA	GMRSD23AA	GMRSD24AA	GMRSD25AA	GMRSD26AA	GMRSD27AA	GMRSD28AA	GMRSD29AA	GMRSD3AA	GMRSD30AA
			sample_date:	11/08/2005	11/10/2005	11/10/2005	11/11/2005	11/11/2005	11/11/2005	11/11/2005	11/11/2005	11/09/2005	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/09/2005	09/26/2007
analyte_type	cas_rn	chemical_name	report_result_unit																						
Metals	7429-90-5	Aluminum	mg/kg	5680	12500	2330	2300	2690	4170	5230	22200	2460	3540	4020	3090	2790	3510	3920	10800	6850	2900	11600	3280	5570	10500
Metals	7440-36-0	Antimony	mg/kg	8.3 U	7.9 U	7.1 U	6.9 U	7.3 U	7.9 U	9.4 U	12 U	7.2 U	8.2 U	9.1 U	6.9 U	7.1 U	8.2 U	7.1 U	14.7 U	9.2 U	8.6 U	39.4 U	8.2 U	8.8 U	8.2 U
Metals	7440-38-2	Arsenic	mg/kg	2.9	9.1	1.7	2.1	3.1	3.5	3.2	15.4	1.3	1.4 J+	2.2 J+	2.4 J+	2.2 J+	2.2 J+	4.1 J+	4.5 J+	8 J+	2.5 J+	6.6 J+	3.1 J+	3.7	8.5 J+
Metals	7440-39-3	Barium	mg/kg	99.1 J	93.1 J	13.9 J	19 J	21.2 J	44.8 J	70.7 J	446 J	13.5 J	57 J	66.9 J	20.2 J	25.1 J	43.1 J	49.3 J	140 J	94.6 J	36.6 J	212 J	49.4 J	56.2 J	142 J
Metals	7440-41-7	Beryllium	mg/kg	0.69 U	0.66 U	0.59 U	0.57 U	0.61 U	0.66 U	0.78 U	1 U	0.6 U	0.68 U	0.76 U	0.58 U	0.59 U	0.69 U	0.76	1.4	0.89	0.72 U	3.3 U	0.69 U	0.73 U	0.74
Metals	7440-43-9	Cadmium	mg/kg	0.76	0.66 U	0.59 U	0.57 U	0.61 U	0.66 U	0.78 U	4.9	0.6 U	0.68 U	0.76 U	0.58 U	0.59 U	0.69 U	0.59 U	1.2 U	0.77 U	0.72 U	3.3 U	0.69 U	0.73 U	1.7
Metals	7440-70-2	Calcium	mg/kg	83200	88000	90900	90600	112000	134000	86700	46400	182000	76400	91700	151000	124000	92600	171000	189000	101000	95200	109000	107000	101000	78100
Metals	7440-47-3	Chromium (total)	mg/kg	34.8 J	26.8 J	7.1 J	5.3 J	6.1 J	8.9 J	12.1 J	224 J	5.9 J	8 J	8.4 J	4.3 J	6.6 J	7.5 J	8.9 J	15.3 J	17.4 J	7.9 J	25 J	9 J	12.6 J	74.4 J
Metals	7440-48-4	Cobalt	mg/kg	6.9 U	10.6	5.9 U	5.7 U	6.1 U	6.6 U	7.8 U	11.9	6 U	6.8 U	7.6 U	5.8 U	5.9 U	6.9 U	5.9 U	12.3 U	7.7 U	7.2 U	32.8 U	6.9 U	7.3 U	6.8 U
Metals	7440-50-8	Copper	mg/kg	21.9	38.5	6.9	4.6	6.1	11.1	21.8	275	4.8	13.5 J+	11.4 J+	6.8 J+	6.1 J+	9.2 J+	4.7 J+	21.2 J+	116 J+	8.5 J+	33.1 J+	10.7 J+	14.9	88.9 J+
Metals	57-12-5	Cyanide	mg/kg	8.86	1.36 U	1.25 U	1.15 U	1.22 U	1.34 U	1.61 U	2 U	1.19 U												1.48 U	
Metals	7439-89-6	Iron	mg/kg	12700	31200	13400	7000	7870	10800	12700	57700	7980	6910	7980	10000	7620	6920	17100	14800	37900	8660	20500	11700	13800	28900
Metals	7439-92-1	Lead	mg/kg	224	18.9	4.2	4.6	5.4	9.1	15.1	224	3.8	8.3	10.3	3.3	4.9	7	6.2	18	2980	8.1	42.5	9.8	12.6	58.7
Metals	7439-95-4	Magnesium	mg/kg	24300 J	27100 J	27600 J	40900 J	28600 J	46000 J	25900 J	13700 J	36700 J	17800 J	18000 J	43200 J	31700 J	30300 J	53800 J	50600 J	16100 J	24900 J	17200 J	21300 J	28100 J	29900 J
Metals	7439-96-5	Manganese	mg/kg	285 J	564 J	217 J	379 J	289 J	481 J	279 J	488 J	259 J	228	258	333	238	218	449	733	544	223	721	307	295 J	231
Metals	7439-97-6	Mercury	mg/kg	0.06	0.05	0.04 U	0.04 U	0.04 U	0.04 U	0.05 U	0.63	0.04 U	0.05 U	0.05 U	0.04 U	0.04 U	0.05 U	0.04 U	0.08 U	0.17	0.05 U	0.23 U	0.04 U	0.05 U	0.28
Metals	7440-02-0	Nickel	mg/kg	10.9	27.9	6.3	4.6 U	4.9 U	9.2	9.9	73.7	5	6.9	8.2	5.1	5.4	6.6	6.2	11.8	22.8	7.1	26.2 U	7.4	9.7	29.7
Metals	7440-09-7	Potassium	mg/kg	933	2370	373	512	635	663	904	2580	361	739	895	332	562	668	482	1680	876	597	2740	795	1030	1660
Metals	7782-49-2	Selenium	mg/kg	1.4 U	1.3 U	1.2 U	1.1 U	1.2 U	1.3 U	1.6 U	2 U	1.2 U	1.5	1.5 U	1.4	1.2 U	1.4 U	1.2 U	3	2.8	1.4 U	6.6 U	1.4 U	1.5 U	2.3
Metals	7440-22-4	Silver	mg/kg	1.4 U	1.3 U	1.2 U	1.1 U	1.2 U	1.3 U	1.6 U	2 U	1.2 U	1.4 U	1.5 U	1.2 U	1.2 U	1.4 U	1.2 U	2.5 U	1.5 U	1.4 U	6.6 U	1.4 U	1.5 U	1.4 U
Metals	7440-23-5	Sodium	mg/kg	185	166	156	135	143	166	163	184	181	203	226	223	195	194	274	685	479	182	810	250	191	219
Metals	7440-28-0	Thallium	mg/kg	6.9 U	6.6 U	5.9 U	5.7 U	6.1 U	6.6 U	7.8 U	10 U	6 U	1.4 U	1.5 U	3.5	1.9	1.4 U	3.9	3.3	2	1.4 U	6.6 U	1.4	7.3 U	1.4 U
Metals	7440-62-2	Vanadium	mg/kg	15.1	26.6	12.9	9.5	10.8	10.3	15.5	44.1	8.3	11.1	9.5	14.5	9.4	9.8	9.3	16.3	11.2	9.6	32.8 U	10.9	16.9	25.9
Metals	7440-66-6	Zinc	mg/kg	151 J	70.2 J	19.4 J	15.5 J	19.5 J	39.8 J	59.3 J	686 J	16.8 J	38.3 J	41.6 J	15.6 J	19.6 J	35.4 J	21.9 J	72.2 J	107 J	29.1 J	145 J	32.6 J	59.6 J	422 J
	7440-44-0	Total Organic Carbon	mg/kg	9140 J	3590 J	1470 J	24200 J	27800 J	9820 J	18900 J	30500 J	9800 J	11700	0	8550	10100	16400	1720	25500	13500	10800	42900	12600	19200 J	19600
	TSOLIDS	Total Solids	percent	72	73.5	80.1	86.7	82	74.9	62.1	50.1	83.8	71.9	63.8	84.9	84.5	72.2	84.9	40.4	63	69.5	14.8	72.1	67.4	70.7

Antimony and silver were never detected.
J Estimated value
R Rejected
U Compound was analyzed but not detected

Appendix A Surficial Sediment Analytical Data - Metals, TOC, and Solids
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

			sys_loc_code:	GMRSD31	GMRSD31	GMRSD32	GMRSD33	GMRSD34	GMRSD4	GMRSD5	GMRSD6	GMRSD7	GMRSD8	GMRSD9
			sys_sample_code:	GMRSD31AA	GMRSD31AB	GMRSD32AA	GMRSD33AA	GMRSD34AA	GMRSD4AA	GMRSD5AA	GMRSD6AA	GMRSD7AA	GMRSD8AA	GMRSD9AA
			sample_date:	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/09/2005	11/09/2005	11/09/2005	11/09/2005	11/08/2005	11/10/2005
analyte_type	cas_rn	chemical_name	report_result_unit											
Metals	7429-90-5	Aluminum	mg/kg	3700	3680	11900	1530	5830	5870	9600	6240	11100	2700	18100
Metals	7440-36-0	Antimony	mg/kg	7 U	7 U	7.4 U	7 U	7.9 U	9.8 U	8.4 U	8.4 U	9.3 U	8.3 U	10.1 U
Metals	7440-38-2	Arsenic	mg/kg	3 J+	6.7 J+	4.4 J+	2.1 J+	3.7 J+	4.3	4.6	2.5	5.8	1.9	10.6
Metals	7440-39-3	Barium	mg/kg	56.5 J	39.8 J	167	17.9 J	92.3 J	73.7 J	523 J	77.4 J	112 J	26.6 J	149 J
Metals	7440-41-7	Beryllium	mg/kg	31	0.63	3	0.58 U	0.66 U	0.81 U	0.7 U	0.7 U	0.78 U	0.69 U	0.84 U
Metals	7440-43-9	Cadmium	mg/kg	0.58 U	0.58 U	0.61 U	0.58 U	0.66 U	0.81 U	1.8	1.2	0.78 U	0.69 U	1.1 J+
Metals	7440-70-2	Calcium	mg/kg	190000	167000	207000	149000	93400	95800	111000	95100	100000	93600	63100
Metals	7440-47-3	Chromium (total)	mg/kg	6.5 J	7 J	12 J	5.2 J	12.7 J	14.9 J	37.8 J	21.6 J	19.7 J	6.7 J	63.3 J
Metals	7440-48-4	Cobalt	mg/kg	5.8 U	5.8 U	6.1 U	5.8 U	6.6 U	8.1 U	7 U	7 U	7.8 U	6.9 U	9.2
Metals	7440-50-8	Copper	mg/kg	6.5 J+	7.4 J+	9.5 J+	3 J+	18.2 J+	17.6	163	24.7	26.2	7	66.2
Metals	57-12-5	Cyanide	mg/kg						1.68 U	1.39 U	1.39 U	1.6 U	1.38 U	1.77 U
Metals	7439-89-6	Iron	mg/kg	8760	9770	7530	5210	11000	17600	23700	14100	22700	6800	34700
Metals	7439-92-1	Lead	mg/kg	9.1	8.5	8.3	3	14	18.3	372	31.3	22.7	5.8	54.2
Metals	7439-95-4	Magnesium	mg/kg	45200 J	37700 J	54300 J	28800 J	21700 J	26600 J	20200 J	24600 J	27200 J	26300 J	21000 J
Metals	7439-96-5	Manganese	mg/kg	411	391	2370	184	327	326 J	349 J	301 J	502 J	191 J	434 J
Metals	7439-97-6	Mercury	mg/kg	0.04	0.04	0.04 U	0.04 U	0.04 U	0.06 U	0.12	0.19	0.05	0.04 U	0.16
Metals	7440-02-0	Nickel	mg/kg	5.9	7.4	4.9 U	4.7 U	11.4	10.9	19.9	12.5	16.8	5.7	31.5
Metals	7440-09-7	Potassium	mg/kg	496	597	2250	304	1250	1050	1020	881	1860	552	2820
Metals	7782-49-2	Selenium	mg/kg	1.2 U	1.3	1.6	1.2 U	1.5	1.7	1.4 U	1.8	1.6 U	1.4 U	1.7
Metals	7440-22-4	Silver	mg/kg	1.2 U	1.2 U	1.2 U	1.2 U	1.3 U	1.6 U	1.4 U	1.4 U	1.6 U	1.4 U	1.7 U
Metals	7440-23-5	Sodium	mg/kg	247	269	849	175	239	207	318	221	199	167	179
Metals	7440-28-0	Thallium	mg/kg	3	3.2	7.8	2	1.5	8.1 U	7 U	7 U	7.8 U	6.9 U	8.4 U
Metals	7440-62-2	Vanadium	mg/kg	7.6	8.8	7.3	6.1	12.8	17.3	17.9	14.3	25.4	8.3	39.4
Metals	7440-66-6	Zinc	mg/kg	24.4 J	26.3 J	23 J	11.4 J	65.1 J	61 J	681 J	107 J	96.8 J	25.3 J	210 J
	7440-44-0	Total Organic Carbon	mg/kg	10300	0	5810	4620	32900	16200 J	14100 J	33400 J	16200 J	12300 J	20200 J
	TSOLIDS	Total Solids	percent	84.8	85.5	81.5	82.6	74.7	59.6	71.7	71.8	62.6	72.3	56.6

Antimony and silver were never detected.
J Estimated value
R Rejected
U Compound was analyzed but not detected

Appendix A Surficial Sediment Analytical Data - PCBs
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

				Upstream of Site in GMR						
			sys_loc_code:	GMRSD15	GMRSD19	GMRSD28	GMRSD29	GMRSD30	GMRSD33	GMRSD34
			sys_sample_code:	GMRSD15AA	GMRSD19AA	GMRSD28AA	GMRSD29AA	GMRSD30AA	GMRSD33AA	GMRSD34AA
			sample_date:	11/10/2005	11/11/2005	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007
analyte_type	cas_rn	chemical_name	report_result_unit							
PCBs	12674-11-2	Aroclor 1016	ug/kg	41 U	66 U	220 U	46 U	47 U	40 U	44 U
PCBs	11104-28-2	Aroclor 1221	ug/kg	84 U	130 U	450 U	93 U	95 U	81 U	90 U
PCBs	11141-16-5	Aroclor 1232	ug/kg	41 U	66 U	220 U	46 U	47 U	40 U	44 U
PCBs	53469-21-9	Aroclor 1242	ug/kg	41 U	66 U	220 U	46 U	47 U	40 U	44 U
PCBs	12672-29-6	Aroclor 1248	ug/kg	230	66 U	250	91	94	62	67
PCBs	11097-69-1	Aroclor 1254	ug/kg	41 U	66 U	220 U	64	97	27 J	74
PCBs	11096-82-5	Aroclor 1260	ug/kg	41 U	66 U	220 U	46 U	47 U	40 U	44 U
PCBs	Total PCBs (ND=0)		ug/kg	230	0	250	155	191	89	141
PCBs	Total PCBs (ND=DL)		ug/kg	353	264	910	247	285	169	229

				Adjacent to Site in GMR										
			sys_loc_code:	GMRSD1	GMRSD14	GMRSD2	GMRSD20	GMRSD20dup	GMRSD21	GMRSD22	GMRSD24	GMRSD25	GMRSD26	GMRSD27
			sys_sample_code:	GMRSD1AA	GMRSD14AA	GMRSD2AA	GMRSD20AA	GMRSD20AB	GMRSD21AA	GMRSD22AA	GMRSD24AA	GMRSD25AA	GMRSD26AA	GMRSD27AA
			sample_date:	11/08/2005	11/10/2005	11/09/2005	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/26/2007	09/26/2007	09/26/2007
analyte_type	cas_rn	chemical_name	report_result_unit											
PCBs	12674-11-2	Aroclor 1016	ug/kg	46 U	45 U	39 U	46 U	52 U	39 U	39 U	39 U	82 U	52 U	47 U
PCBs	11104-28-2	Aroclor 1221	ug/kg	93 U	91 U	80 U	93 U	110 U	79 U	79 U	79 U	170 U	110 U	96 U
PCBs	11141-16-5	Aroclor 1232	ug/kg	46 U	45 U	39 U	46 U	52 U	39 U	39 U	39 U	82 U	52 U	47 U
PCBs	53469-21-9	Aroclor 1242	ug/kg	46 U	45 U	39 U	46 U	52 U	39 U	39 U	39 U	82 U	52 U	47 U
PCBs	12672-29-6	Aroclor 1248	ug/kg	290	45 U	95	67	80	26 J	43	77	130	170	130
PCBs	11097-69-1	Aroclor 1254	ug/kg	260	45 U	39 U	58 J	76	27 J	34 J	55	120 J	110	81 J
PCBs	11096-82-5	Aroclor 1260	ug/kg	56	45 U	39 U	46 U	52 U	39 U	39 U	39 U	82 U	52 U	47 U
PCBs	Total PCBs (ND=0)		ug/kg	606	0	95	125	156	53	77	132	250	280	211
PCBs	Total PCBs (ND=DL)		ug/kg	652	180	212	217	260	131	155	210	414	384	305

				Adjacent to Site in GMR (cont.)												
			sys_loc_code:	GMRSD3	GMRSD31	GMRSD31dup	GMRSD32	GMRSD4	GMRSD5	GMRSD6	GMRSD7	GMRSD8	GMRSD9	GMRSD16	GMRSD17	GMRSD18
			sys_sample_code:	GMRSD3AA	GMRSD31AA	GMRSD31AB	GMRSD32AA	GMRSD4AA	GMRSD5AA	GMRSD6AA	GMRSD7AA	GMRSD8AA	GMRSD9AA	GMRSD16AA	GMRSD17AA	GMRSD18AA
			sample_date:	11/09/2005	09/26/2007	09/26/2007	09/26/2007	11/09/2005	11/09/2005	11/09/2005	11/09/2005	11/08/2005	11/10/2005	11/11/2005	11/11/2005	11/11/2005
analyte_type	cas_rn	chemical_name	report_result_unit													
PCBs	12674-11-2	Aroclor 1016	ug/kg	49 U	39 U	39 U	40 U	55 U	46 U	230 U	53 U	46 U	58 U	38 U	44 U	53 U
PCBs	11104-28-2	Aroclor 1221	ug/kg	99 U	79 U	78 U	82 U	110 U	93 U	470 U	110 U	93 U	120 U	77 U	89 U	110 U
PCBs	11141-16-5	Aroclor 1232	ug/kg	49 U	39 U	39 U	40 U	55 U	46 U	230 U	53 U	46 U	58 U	38 U	44 U	53 U
PCBs	53469-21-9	Aroclor 1242	ug/kg	49 U	270 J	180 J	40 U	55 U	46 U	230 U	53 U	46 U	58 U	38 U	44 U	53 U
PCBs	12672-29-6	Aroclor 1248	ug/kg	220	39 U	39 U	90	240	440	1300	140	280	86	38 U	130	240
PCBs	11097-69-1	Aroclor 1254	ug/kg	49 U	110	79	57	55 U	46 U	230 U	53 U	46 U	58 U	38 U	44 U	53 U
PCBs	11096-82-5	Aroclor 1260	ug/kg	49 U	39 U	39 U	40 U	55 U	25 J	940	53 U	46 U	36 J	38 U	44 U	53 U
PCBs	Total PCBs (ND=0)		ug/kg	220	380	259	147	240	465	2240	140	280	10005	0	130	240
PCBs	Total PCBs (ND=DL)		ug/kg	367	458	337	227	405	557	2700	299	418	10005	152	262	399

				Downstream
			sys_loc_code:	GMRSD23
			sys_sample_code:	GMRSD23AA
			sample_date:	09/25/2007
analyte_type	cas_rn	chemical_name	report_result_unit	
PCBs	12674-11-2	Aroclor 1016	ug/kg	46 U
PCBs	11104-28-2	Aroclor 1221	ug/kg	93 U
PCBs	11141-16-5	Aroclor 1232	ug/kg	46 U
PCBs	53469-21-9	Aroclor 1242	ug/kg	46 U
PCBs	12672-29-6	Aroclor 1248	ug/kg	54
PCBs	11097-69-1	Aroclor 1254	ug/kg	46 U
PCBs	11096-82-5	Aroclor 1260	ug/kg	46 U
PCBs	Total PCBs (ND=0)		ug/kg	54
PCBs	Total PCBs (ND=DL)		ug/kg	192

(ND = 0) - Non-detects not included in sum for
(ND = DL) - Full detection limit value used as

Aroclors 1016, 1221, and 1232 were never detected and were not included in the Total PCB calculation.
J Estimated value
R Rejected
U Compound was analyzed but not detected

Appendix A Surficial Sediment Analytical Data - PAHs
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

			sys_loc_code:	GMRSD1	GMRSD14	GMRSD15	GMRSD16	GMRSD16	GMRSD17	GMRSD18	GMRSD19	GMRSD2	GMRSD20	GMRSD20	GMRSD21	GMRSD22	GMRSD23	GMRSD24	GMRSD25	GMRSD26	GMRSD27	GMRSD28	GMRSD29
			sys_sample_code:	GMRSD1AA	GMRSD14AA	GMRSD15AA	GMRSD16AA	GMRSD16AB	GMRSD17AA	GMRSD18AA	GMRSD19AA	GMRSD2AA	GMRSD20AA	GMRSD20AB	GMRSD21AA	GMRSD22AA	GMRSD23AA	GMRSD24AA	GMRSD25AA	GMRSD26AA	GMRSD27AA	GMRSD28AA	GMRSD29AA
			sample_date:	11/08/2005	11/10/2005	11/10/2005	11/11/2005	11/11/2005	11/11/2005	11/11/2005	11/11/2005	11/09/2005	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007
analyte_type	cas_rn	chemical_name	report_result_unit																				
PAHs	120-12-7	Anthracene	ug/kg	88 J	330 J	14 J	39 UJ	23 J	180 UJ	140 J	530 J	38 UJ	1400 U	1000 U	57 J	390 U	1400 U	67 J	180 J	240 J	48 J	4500 U	390 J
PAHs	129-00-0	Pyrene	ug/kg	460 J	980 J	84 J	77 J	96 J	360 J	1100 J	2500 J	66 J	290 J	570 J	290 J	360 J	150 J	490 J	1400	1200	310 J	650 J	2100
PAHs	191-24-2	Benzo(g,h,i)perylene	ug/kg	180 UJ	230 J	20 J	39 J	48 J	170 J	460 J	620 J	38 UJ	130 J	200 J	110 J	110 J	86 J	240 J	640 J	600	130 J	440 J	580
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	ug/kg	150 J	220 J	18 J	34 J	42 J	150 J	400 J	580 J	38 UJ	120 J	170 J	100 J	84 J	76 J	210 J	570 J	570	120 J	390 J	500
PAHs	205-99-2	Benzo(b)fluoranthene	ug/kg	310 J	480 J	33 J	62 J	77 J	250 J	770 J	1200 J	38 UJ	190 J	280 J	160 J	110 J	110 J	290 J	800 J	960	180 J	600 J	800
PAHs	206-44-0	Fluoranthene	ug/kg	620 J	1300 J	96 J	99 J	120 J	430 J	1400 J	2500 J	69 J	410 J	800 J	420	240 J	210 J	520 J	1800	1800	460 J	950 J	3100
PAHs	207-08-9	Benzo(k)fluoranthene	ug/kg	110 J	160 J	11 J	19 J	52 J	190 J	560 J	680 J	38 UJ	160 J	210 J	170 J	110 J	110 J	290 J	780 J	890	170 J	490 J	730
PAHs	208-96-8	Acenaphthylene	ug/kg	180 UJ	78 J	25 UJ	39 UJ	40 UJ	180 UJ	510 UJ	1200 UJ	38 UJ	1400 U	1000 U	390 U	36 J	1400 U	85 J	120 J	220 J	470 U	4500 U	460 U
PAHs	218-01-9	Chrysene	ug/kg	270 J	440 J	47 J	48 J	62 J	230 J	660 J	1700 J	15 J	210 J	310 J	210 J	160 J	120 J	300 J	880	960	220 J	550 J	1100
PAHs	50-32-8	Benzo(a)pyrene	ug/kg	310 J	460 J	42 J	67 J	77 J	280 J	850 J	1600 J	36 J	190 J	240 J	190 J	170 J	110 J	320 J	850	1000	180 J	500 J	820
PAHs	53-70-3	Dibenz(a,h)anthracene	ug/kg	180 UJ	66 J	25 U	39 U	12 J	180 U	510 U	1200 U	38 U	1400 U	1000 U	32 J	22 J	1400 U	68 J	160 J	180 J	32 J	4500 U	160 J
PAHs	56-55-3	Benzo(a)anthracene	ug/kg	230 J	510 J	25 J	34 J	45 J	160 J	520 J	910 J	19 UJ	170 J	240 J	210 J	140 J	76 J	290 J	760 J	920	170 J	370 J	870
PAHs	83-32-9	Acenaphthene	ug/kg	180 U	170 U	25 U	39 U	40 U	180 U	510 U	1200 U	38 U	1400 U	1000 U	390 U	390 U	1400 U	26 J	820 U	120 J	470 U	4500 U	140 J
PAHs	85-01-8	Phenanthrene	ug/kg	180 UB	700 JB	47 J	39 UB	50 J	210 J	560 J	1100 J	42 J	250 J	320 J	190 J	36 J	75 J	160 J	680 J	600	200 J	310 J	2800
PAHs	86-73-7	Fluorene	ug/kg	180 UJ	79 J	7.7 J	39 UJ	19 J	180 UJ	510 UJ	330 J	38 UJ	1400 U	1000 U	390 U	390 U	1400 U	390 U	820 U	82 J	470 U	4500 U	210 J
PAHs	91-20-3	Naphthalene	ug/kg	180 UJ	170 UJ	25 UJ	39 UJ	40 UJ	180 UJ	510 UJ	1200 UJ	38 UJ	1400 U	1000 U	390 U	390 U	1400 U	70 J	52 J	760	470 U	4500 U	71 J
PAHs	Total PAHs (ND=0)		ug/kg	2548	6033	444.7	479	723	2430	7420	14250	228	2120	3340	2139	1578	1123	3426	9672	11102	2220	5250	14371
PAHs	Total PAHs (ND=DL)		ug/kg	3808	6373	544.7	752	843	3510	9970	19050	627	10520	9340	3699	3138	9523	3816	11312	11102	4100	32250	14831

(ND = 0) - Non-detects not included in sum for Total PAHs.

(ND = DL) - Full detection limit value used as surrogate for non-detect compounds in sum for Total PAHs.

J Estimated value
R Rejected
U Compound was analyzed but not detected

Appendix A Surficial Sediment Analytical Data - PAHs
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

			sys_loc_code:	GMRSD3	GMRSD30	GMRSD31	GMRSD31	GMRSD32	GMRSD33	GMRSD34	GMRSD4	GMRSD5	GMRSD6	GMRSD7	GMRSD8	GMRSD9
			sys_sample_code:	GMRSD3AA	GMRSD30AA	GMRSD31AA	GMRSD31AB	GMRSD32AA	GMRSD33AA	GMRSD34AA	GMRSD4AA	GMRSD5AA	GMRSD6AA	GMRSD7AA	GMRSD8AA	GMRSD9AA
			sample_date:	11/09/2005	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/09/2005	11/09/2005	11/09/2005	11/09/2005	11/08/2005	11/10/2005
analyte_type	cas_rn	chemical_name	report_result_unit													
PAHs	120-12-7	Anthracene	ug/kg	67 J	77 J	5800	5100	66 J	400 U	880 U	130 J	19 J	130000	430 J	40 J	300 J
PAHs	129-00-0	Pyrene	ug/kg	710 J	410 J	19000	17000	300 J	400 U	270 J	900 J	200 J	380000	2100 J	230 J	1300 J
PAHs	191-24-2	Benzo(g,h,i)perylene	ug/kg	300 J	150 J	6400	6400	140 J	400 U	180 J	350 J	110 J	110000	760 J	73 J	620 J
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	ug/kg	250 J	130 J	5500	5500	130 J	400 U	160 J	300 J	96 J	92000	700 J	65 J	530 J
PAHs	205-99-2	Benzo(b)fluoranthene	ug/kg	430 J	270 J	7500	7400	200 J	400 U	230 J	620 J	140 J	130000	1300 J	130 J	1100 J
PAHs	206-44-0	Fluoranthene	ug/kg	830 J	500	24000	23000	410	32 J	360 J	1200 J	240 J	430000	2700 J	280 J	1600 J
PAHs	207-08-9	Benzo(k)fluoranthene	ug/kg	330 J	250 J	7500	7500	180 J	400 U	190 J	390 J	120 J	130000	560	45 J	460 J
PAHs	208-96-8	Acenaphthylene	ug/kg	42 J	48 J	2000	2000	69 J	400 U	880 U	59 J	45 UJ	74000	210 J	66 UJ	120 J
PAHs	218-01-9	Chrysene	ug/kg	420 J	400 J	8400	7800	220 J	17 J	210 J	500 J	140 J	170000	1100 J	120 J	890 J
PAHs	50-32-8	Benzo(a)pyrene	ug/kg	400 J	210 J	10000	10000	210 J	400 U	190 J	490 J	130 J	170000	1100 J	140 J	850 J
PAHs	53-70-3	Dibenz(a,h)anthracene	ug/kg	56 J	46 J	1600 J	1600 J	48 J	400 U	59 J	88 J	16 J	26000 J	200 J	66 U	150 J
PAHs	56-55-3	Benzo(a)anthracene	ug/kg	340 J	220 J	9700	9600	200 J	400 U	140 J	440 J	100 J	180000	1200 J	120 J	790 J
PAHs	83-32-9	Acenaphthene	ug/kg	140 U	470 U	3300	5300	400 U	400 U	880 U	71 J	45 U	13000 J	69 J	66 U	160 J
PAHs	85-01-8	Phenanthrene	ug/kg	320 JB	220 J	17000	16000	190 J	400 U	120 J	490 J	100 J	380000	1300 JB	120 J	890 JB
PAHs	86-73-7	Fluorene	ug/kg	140 UJ	470 U	3500	4100	400 U	400 U	880 U	62 J	45 UJ	36000 J	85 J	19 J	150 J
PAHs	91-20-3	Naphthalene	ug/kg	140 UJ	470 U	880 J	510 J	42 J	400 U	880 U	150 UJ	45 UJ	14000 J	200 UJ	66 UJ	95 J
PAHs	Total PAHs (ND=0)		ug/kg	4495	2931	132080	128810	2405	49	2109	6090	1411	2465000	13814	1382	10005
PAHs	Total PAHs (ND=DL)		ug/kg	4915	4341	132080	128810	3205	5649	6509	6240	1591	2465000	14014	1646	10005

(ND = 0) - Non-detects not included in sum for Total PAHs.

(ND = DL) - Full detection limit value used as surrogate for non-detect compounds in sum for Total PAHs.

J Estimated value
R Rejected
U Compound was analyzed but not detected

Appendix A Surficial Sediment Analytical Data - SEM and AVS, TOC, and Solids
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio

			sys_loc_code:	GMRSD17	GMRSD20	GMRSD20	GMRSD21	GMRSD22	GMRSD23	GMRSD24	GMRSD25	GMRSD26	GMRSD27	GMRSD28	GMRSD29	GMRSD3	GMRSD30	GMRSD31	GMRSD31	GMRSD32	GMRSD33	GMRSD34	GMRSD5	GMRSD8
			sys_sample_code:	GMRSD17AASEM	GMRSD20AA	GMRSD20AB	GMRSD21AA	GMRSD22AA	GMRSD23AA	GMRSD24AA	GMRSD25AA	GMRSD26AA	GMRSD27AA	GMRSD28AA	GMRSD29AA	GMRSD3AASEM	GMRSD30AA	GMRSD31AA	GMRSD31AB	GMRSD32AA	GMRSD33AA	GMRSD34AA	GMRSD5AASEM	GMRSD8AASEM
			sample_date:	11/11/2005	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/25/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/09/2005	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	09/26/2007	11/09/2005	11/08/2005
analyte_type	cas_rn	chemical_name	report_result_unit																					
AVSSEM	SULFIDE-AV	Sulfide, acid-volatile	umoles/g	1.27 U	2.12	2.07	1.03	0.12 U	1.89 U	0.732	1.82	3.06	1.72	10.6	0.143	2.39	0.143 U	2.1	2.58	2.16	0.121 U	0.136 U	6.96	6.61
AVSSEM	7440-43-9	Cadmium	umoles/g	0.00116 J-	0.000978 J-	0.00133 J-	0.000543 J	0.000525 UJ	0.00089 J-	0.00116 J-	0.000801 J-	0.000632 U	0.000578 UJ	0.00374 J-	0.000578 UJ	0.00142 J-	0.00694 J-	0.000801 J-	0.000534 UJ	0.00056 UJ	0.000525 UJ	0.000596 UJ	0.00596 J-	0.000712 J-
AVSSEM	7440-50-8	Copper	umoles/g	0.115	0.085 J	0.107 J	0.0252 J	0.0134 J	0.0771 J	0.0582 J	0.0582 J	0.0692 J	0.0393 J	0.312 J	0.0283 J	0.108	0.51 J	0.0315 J	0.0157 J	0.0252 J	0.0135 J	0.0378 J	0.252	0.0582
AVSSEM	7439-92-1	Lead	umoles/g	0.0536 J-	0.028 J	0.0405 J	0.00772 J	0.00579 J	0.0246 J	0.0106 J	0.0217 J	0.0333 J	0.0164 J	0.132 J	0.0121 J	0.0338 J-	0.111 J	0.0125 J	0.0082 J	0.0116 J	0.00531 J	0.0121 J	0.097 J-	0.0222 J-
AVSSEM	7440-02-0	Nickel	umoles/g	0.0511 J-	0.0409	0.046	0.0145	0.0092	0.0324	0.0141	0.0221	0.0221	0.0256	0.143	0.0148	0.0579 J-	0.121	0.0187	0.0121	0.0133	0.0134	0.0221	0.0988 J-	0.0426 J-
AVSSEM	7440-66-6	Zinc	umoles/g	0.257 J	0.317 J	0.428 J	0.19 J	0.052 J	0.266 J	0.525 J	0.205 J	0.269 J	0.141 J	1.44 J	0.107 J	0.367 J	2.62 J	0.182 J	0.0887 J	0.116 J	0.0627 J	0.138 J	1.4 J-	0.216 J
	7440-44-0	Total Organic Carbon	mg/kg		11700		8550	10100	16400	1720	25500	13500	10800	42900	12600	0	19600	10300		5810	4620	32900		
	TSOLIDS	Total Solids	percent	78.9	71.9	63.8	84.9	84.5	72.2	84.9	40.4	63	69.5	14.8	72.1	67.4	70.7	84.8	85.5	81.5	82.6	74.7	69.4	76.9

J Estimated value
R Rejected
U Compound was analyzed but not detected

APPENDIX B
FISH AND BENTHIC SURVEY OF THE GREAT MIAMI RIVER, 2008

KEMRON
ENVIRONMENTAL SERVICES

156 Starlite Drive ▪ Marietta, OH 45750 ▪ TEL (740) 373-4308 ▪ FAX (740) 376-2536 ▪ http://www.kemron.com

May 30, 2008

Mr. Pablo Valentin
Remedial Project Manager
US EPA, Region 5
Superfund Division, RRB1/RRS3
77 West Jackson Blvd.
Chicago, IL 60604

RE: Revised Biocriteria Study and Responses to Ohio EPA Comments, Former ARMCO Hamilton Plant, New Miami, Ohio

Dear Mr. Valentin:

On behalf of AK Steel Corporation, KEMRON Environmental Services, Inc., (KEMRON) is pleased to provide the enclosed responses to the May 15, 2008 Ohio EPA comments and revisions to the report entitled *Fish and Benthic Survey of the Great Miami River, 2007*. The enclosed May 2008, Revision 1.0 version of the report has been edited to address Ohio EPA's comments. The data contained in the enclosed report was collected and evaluated by EA Engineering, Science, and Technology, Inc.

We trust that the enclosed responses to comments and revised report adequately address the Ohio EPA comments, and look forward to receipt of US EPA and Ohio EPA written concurrence with the revised report.

Please feel free to contact me at (740) 373-1266 or at mrochotte@kemron.com if you have any questions.

Sincerely,
KEMRON Environmental Services, Inc.

Mary Lou Rochotte

Mary Lou Rochotte
Senior Project Manager

Enclosures

Kemron Environmental Services

cc w/enclosure: Dave Miracle, AK Steel Corporation
Nita Nordstrom, OEPA, DERR, SWDO
Brian Tucker, OEPA, CO, Remedial Response Section
David Altfater, OEPA, DSW, Ecological Assessment Section
Amber Bixler, Tetra Tech EMI
Wendy Coates, AK Steel Asset Management

RESPONSES TO OHIO EPA MAY 15, 2008 COMMENTS ON AK STEEL FISH AND BENTHIC SURVEY OF THE GREAT MIAMI RIVER (GMR), MAY 2008

AK Steel Corporation (AK Steel) and its oversight contractor for the Former ARMCO Hamilton, Ohio plant, KEMRON Environmental Services, Inc. (KEMRON), submitted the *Fish and Benthic Survey of the Great Miami River, 2007* to Ohio EPA and US EPA on May 02, 2008. AK Steel and KEMRON received Ohio EPA's comments on the report via email on May 15, 2008. Comments from Ohio EPA were prepared by Mr. David Altfater, Ohio EPA, Division of Surface Water, Ecological Assessment Section. Mr. Altfater's comments were forwarded by Ms. Nita Nordstrom, Ohio EPA, DERR Site Coordinator.

KEMRON and its subcontractor, EA Engineering, Science, and Technology, Inc., have prepared the following responses to comments and the attached revised report on behalf of AK Steel.

***Comment* # 1 -** *I concur with the findings in the executive summary and conclusion sections that the former ARMCO Hamilton plant does not adversely affect the biological communities in adjacent and downstream portions of the Great Miami River.*

Response – No change in the report necessary.

Comment # 2 - *Table 12 needs to be added to the final version of the report.*

Response - Table 12 has been added to the report.

Comment # 3 - *Section 2.3, page 6: A statement is made that "In Ohio, attainment of the benthic community can only be determined by calculating the ICI." This is typically the case; however, decisions about full, partial, or non attainment have been made by Ohio EPA based on an evaluation of qualitative data (narrative evaluations) using best professional judgment.*

Response – We concur that attainment of the benthic community is typically determined using the ICI but acknowledge that Ohio EPA occasionally uses best professional judgment. The text of the report has been edited accordingly.

Comment # 4 - *Section 3.3, page 12: I do not agree with the predominant substrate types noted for site GMRF27. I would agree that artificial substrates and silt were common along the river margins (and silt/sand was common along one area offish sampling on the river left at woody structure). However, cobble and gravel were predominant further out from the river margins where fish sampling occurred. The low substrate score was a large factor in the lower QHEI score.*

Response - Mr. Altfater states that artificial and silt substrates were common along the river margins. Mr. Altfater further states, "cobble and gravel were predominant further out from the river margins where fish sampling occurred". EA and AK Steel agree that cobble and gravel were predominant further from shore, but the majority of electrofishing sampling took place near shore along the right and left descending banks at GMRF27. Based on our observations, silt was predominant along the left descending bank and artificial along the right. However, we acknowledge and have documented that gravel/cobble were also common, particularly along the right descending bank. It is quite possible that the artificial substrate, which is visible along much of the right descending bank, was overestimated (i.e., functionally limited and did not extend as far into the channel as originally thought). As such, we accept that gravel can be considered a predominant type but contend that silt is also a predominant substrate type at GMRF27. The text and tables have been edited accordingly.

Comment # 5 - *The discussion of sample results for benthic sample GMRSD21 throughout the report are appropriate. However, based on the severe flow restrictions at this sample location, the results should not be included in the attainment determination in Table 12. Additionally, the summarized attainment box at the bottom of Table 12 (noted as adjacent and downstream mean) should be eliminated. Attainment status is based on a site by site evaluation, not the mean of the sites.*

Response - We agree with Mr. Altfater that the confounding influence of slow current velocity at GMRSD21 likely diminishes the value of the benthic data from that location. Therefore, we have edited Table 12 and the report text to reflect the exclusion of GMRSD21 from the attainment evaluation. Furthermore, although we have retained the bottom row of Table 12 (Adjacent & Downstream Mean), we acknowledge that, as per Ohio EPA, attainment is based on a site-by-site evaluation. Therefore, we have removed the reference to attainment associated with these mean values in Table 12.

Fish and Benthic Survey
of
the Great Miami River, 2007

Prepared for:

AKSteel

AK Steel Corporation
9227 Centre Pointe Drive
West Chester, OH 45069

Prepared by:

EA Engineering, Science, and Technology, Inc.
444 Lake Cook Road, Suite 18
Deerfield, IL 60015

and

KEMRON Environmental Services, Inc.
156 Starlite Drive
Marietta, OH 43756

May 2008

Revision 1.0

EA Project 1451801

TABLE OF CONTENTS

FIGURE

TABLES

EXECUTIVE SUMMARY

During September and October 2007, fish and macroinvertebrate communities were sampled at multiple locations in the Great Miami River using standard Ohio Environmental Protection Agency (Ohio EPA) sampling protocols and according to procedures outlined in the Ohio EPA approved "Ecological Risk Assessment Supplemental Work Plan for the Former ARMCO Hamilton Plant Site" (ENSR 2007).

The former ARMCO Hamilton plant (site), located in Hamilton, Butler County, Ohio, was operated as a steel mill. Operations ceased in 1982, and most of the on-site buildings were demolished by 1989. Ownership of the site has since transferred to AK Steel Corporation, who is conducting a remedial investigation in conformance to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The Ecological Risk Assessment Supplemental Work Plan was developed and implemented to provide additional data for incorporation into a Baseline Ecological Risk Assessment of the site under CERCLA and the NCP. The data were collected to assess the integrity and well being of the fish and invertebrate community within the Great Miami River upstream, adjacent to and downstream of the site. A healthy aquatic community reflected by the data would indicate that the site is not having a negative impact upon the river that would merit an ecologically based CERCLA response action.

In conformance with the approved plan, one fish and three macroinvertebrate locations were situated upstream of the site with four fish and eight macroinvertebrate locations adjacent to or downstream of the site. Three biological indices were calculated to evaluate the fish and benthic communities: Index of Biotic Integrity (IBI), Modified Index of Well-Being (IWBmod), and Invertebrate Community Index (ICI).

The community specific data, index scores, associated Qualitative Habitat Evaluation Index (QHEI) results, and other habitat observations indicate that the AK Steel Hamilton Site does not adversely affect the biological communities in adjacent and downstream portions of the Great Miami River. As a result, no further investigation of the Great Miami River for purposes of ecological risk assessment is warranted for this site. The data from this study will be incorporated into the site Baseline Ecological Risk Assessment.

1. INTRODUCTION

This report describes the fish, macroinvertebrate, and habitat assessment EA conducted in the Great Miami River during September and October 2007 relevant to the Former ARMCO Hamilton plant, located at 401 Augspurger Road, New Miami, Ohio. The site is bordered to the south and east by the Great Miami River. US EPA, OEPA and AK Steel agreed that a study of the ecological conditions within the river was appropriate to determine what, if any, impacts the site is having on the ecological communities in the river. A work plan for the investigation was developed to assess conditions in the river as they relate to the site's impact under CERCLA and the NCP. This report provides the results of that assessment. This study was conducted according to OEPA methodologies (OEPA 1989, 2006b, and 2006c) and procedures outlined in the Ohio EPA approved "Ecological Risk Assessment Supplemental Work Plan for the Former Armco Hamilton Plant Site" (ENSR 2007).

2. METHODS

2.1 FISH

2.1.1 Field

Fish sampling in each zone was conducted for 500 m using a 12' electrofishing boat according to standard OEPA guidance (OEPA 1989). Collections were made on 6-7 September 2007 and 10-11 October. A 5,000-watt generator and a Smith-Root type VI electrofisher were used to sample fish. All fish collected were identified, counted, batch weighed, and examined for Deformities, Erosion, Lesions, and Tumors; collectively known as DELT anomalies. In conjunction with the fish sampling, habitat was assessed at each location using the Qualitative Habitat Evaluation Index (QHEI).

2.1.2 Sampling Stations

To assess the condition of the fish community and physical habitat in the Great Miami River near the AK Steel Hamilton Site, five fish sampling zones were established from River Mile (RM) 37.7 to 40.3 (Figure 1):

GMRF30 – The start of this zone was located 0.75 mile downstream of a low-head dam and ended 250 m upstream of the AOC 7 ditch. The entire zone was located above the AK Steel Hamilton Site to document background conditions of the fish community. The zone consisted of deep and slow pool/glide habitat upstream with faster and shallower riffle/run habitat downstream. Sampling alternated between both right and left descending banks. For the purpose of determining attainment, the fish sampling zone included the benthic macroinvertebrate sampling locations GMRSD30, 29, and 28.

GMRF27 – Sampling began immediately downstream of the AOC 7 ditch and proceeded downstream for 500 m. The zone consisted entirely of slow and deep pool/glide habitat without a riffle. Sampling alternated between both right and left descending banks. The fish results for this zone were considered in conjunction with GMRSD27 benthos results for attainment purposes.

GMRF25 – This zone began downstream of AOC 13 and ended 30 m upstream of the AK Steel Hamilton Site intake structure. Habitat in the zone ranged from slow and relatively deep glide habitat upstream to shallow and fast riffle/run habitat downstream. Sampling was conducted primarily along the right descending bank. In order to determine attainment, results from GMRF25 were assessed collectively with the benthos results from sampling locations GMRSD26, 25, 24, and 22.

GMRF20R – The start of this sampling zone was located approximately 90 m downstream of the AK Steel Hamilton Site intake structure and ended approximately 75 m upstream of a railroad bridge and the Hwy. 127 Bridge. The zone largely consisted of shallow and slow glide habitat without a riffle. In order to determine attainment, results from GMRF20R were assessed collectively with the fish results from GMRF20L and benthos results from sampling locations GMRSD21, 20, and 23.

GMRF20L – This sampling zone ran parallel on the opposite (left descending) bank as GMRF20R. This zone was added at the suggestion of Mr. Dave Altfater (OEPA – pers. comm.) because of relatively better habitat compared to GMRF20R. General habitat conditions on this side of the river were similarly slow but with more depth and cover. Benthic data from GMRSD21, 20, and 23 as well as fish results from GMRF20R were considered together with GMRF20L to determine attainment.

2.1.3 Laboratory

Whenever possible, fish were identified in the field and released. However, fish of uncertain identity were preserved in 10% formalin and returned to the EA lab for further examination. Laboratory fish were processed in the same manner as those collected in the field.

2.1.4 Data Analyses

All fish data collected were entered into a SAS database and printouts of that database were compared against the original data sheets to check for data entry errors. After any errors were corrected, summary tables were prepared and index scores calculated. The fish community indices that were used include the Index of Biotic Integrity (IBI) and the Modified Index of Well-being (IWBmod). OEPA's IBI (OEPA 1988 and 2006b) is a multi-metric index patterned after the IBI originally described by Karr (1981) and Fausch et al. (1984). The IBI uses 12 metrics to assess the health of the fish community. Metrics include such variables as number of species collected, catch rate, number of sunfish species, etc. Each metric receives a score of 1, 3, or 5; thus the total score can range from 12 to 60. The IWBmod is a measure of fish community abundance and diversity using numbers and weight; it is OEPA's modification (OEPA 1988 and 2006b) of the original Index of Well-being developed for the Wabash River in Indiana (Gammon 1976; Gammon et al. 1981). EA has computer programs that calculate these scores using OEPA protocols and which have successfully duplicated scores calculated by OEPA at a number of sites. In addition to IBI and IWBmod scores, EA calculated catch-per-unit-effort (number of fish per km), species richness, and percent composition.

2.2 MACROINVERTEBRATES

Macroinvertebrates were surveyed quantitatively and qualitatively at each of the three stations using OEPA methodologies (OEPA 1989 and 2006c). Quantitative collections were made with modified Hester-Dendy artificial substrate samplers (HD). HDs were set on 14-15 August and retrieved on 25-26 September. Qualitative samples were collected by kick netting and handpicking during HD retrieval.

2.2.1 Quantitative Sampling

Each HD sampler consisted of eight 3x3 inch plates constructed from 1/8 inch tempered hardboard and twelve 1/8 plastic spacers. The plates and spacers were arranged on a 1/4 inch eye bolt so that each sampler had three 1/8 inch spaces, three 1/4 inch spaces, and one 3/8 inch space among the plates. The total surface area of a single sampler, excluding the eye bolt, was 1.01 square feet. A single sample consisted of five HDs attached to a concrete block. Duplicate HD sets were deployed at each location to minimize the loss of samplers (e.g., vandalism). Where possible, samplers were placed in run habitats or at least in areas with the highest measured current velocity. At most locations, the HD samplers were set by wading from shore. However, in deeper more pooled areas, OEPA has recently had more success deploying samplers on the bottom in the channel, compared to wadeable shoreline sets (Mr. Jeffrey DeShon-OEPA, pers. comm.; OEPA 2007). Therefore, at unwadeable locations with pool/glide habitat, the samplers were deployed by boat. Regardless of deployment method, the HD samplers remained in place for a six-week colonization period. Retrieval of the HDs was accomplished by placing a benthos sieve in the water just downstream of the sampler. The individual samplers were then cut from the concrete block and carefully placed in the sieve to reduce the loss of organisms. All five HDs and material from the sieve were placed in a single labeled container and preserved with 10% formalin.

2.2.2 Qualitative Sampling

Qualitative samples were collected concurrent with retrieval of the HDs in adjacent wadeable areas. All discernable habitats were sampled using a 30-mesh delta net (kicks and sweeps) and by handpicking selected substrates for 70-120 (mean=84) person-minutes per station, depending on organism and habitat diversity. Collected organisms were placed in labeled jars and preserved with 10% formalin.

2.2.3 Sampling Stations

To assess the condition of the benthic macroinvertebrate community in the Great Miami River near the AK Steel Hamilton Site, 11 macroinvertebrate sampling locations were established from River Mile (RM) 37.7 to 40.3 (Figure 1):

GMRSD30 – The samplers were deployed along the right descending bank by wading from shore in deep glide habitat with slow current velocity and boulder to gravel substrate.

GMRSD29 – The samplers were set approximately mid-channel by wading in a broad riffle/run complex with swift current velocity and cobble to large gravel substrate.

GMRSD28 –The samplers were set approximately mid-channel by wading in deep run habitat with moderate to fast current velocity and unconsolidated gravel substrate. However, upon retrieval, the samplers were missing.

GMRSD27 – The samplers were deployed remotely by boat and set on the bottom at depths of approximately two to three meters in deep glide habitat with moderate current velocity. Like GMRSD28, the samplers were missing upon retrieval. However, based on the cut anchor lines, it appears that the samplers had been vandalized.

GMRSD26 – The samplers were deployed along the right descending bank by wading in glide habitat with very slow current velocity and cobble to gravel substrate. Upon retrieval, it was noted that both sets of samplers had moved downstream with one set on its side.

GMRSD25 – The samplers were set by wading from shore along the right descending bank of the river. This location consisted of glide habitat with slow current velocity and largely gravel substrate.

GMRSD24 – The samplers were deployed in run habitat along the right descending bank by wading. The current velocity was fast and the substrate consisted of largely cobble and large gravel.

GMRSD22 – The samplers were set by wading in run habitat along the right descending bank. The current velocity was fast and the substrate consisted of largely cobble.

GMRSD21 – The samplers were set by wading along the right descending bank in pool habitat with cobble, gravel, and silt substrate. Current velocity was nearly undetectable during both the set and retrieval. Upon retrieval, one set of samplers was missing and the other set had been moved from its original set location.

GMRSD20 – The samplers were deployed remotely by boat and set on the bottom at depths of approximately two meters in deep glide/pool habitat with slow current velocity. The samplers were set along the left descending bank where they were anchored to shore.

GMRSD23 – The samplers were deployed remotely by boat along the left descending bank and set on the bottom at depths of approximately two meters in pool habitat with slow current velocity. It appears flow in this area is at least periodically affected by the downstream low-head dam.

2.2.4 Laboratory Processing

Upon arrival at the laboratory, the samples were logged in and accounted for. Based on measured current velocity, the amount of silt/debris caught on the samplers and the numbers and types of organisms observed during retrieval, one of the two HD arrays from each location was initially processed. The second HD array was kept as a backup. The five HDs from each array were disassembled in a water filled enamel pan and cleaned of organisms and debris. This mixture was then passed through a No. 60 (250 μm mesh) U.S. Standard Testing Sieve and preserved in labeled containers containing 10% formalin. Sorting of each HD and qualitative sample was conducted in grided petri dishes under a dissecting stereo-scope at 10X magnification. HD samples were initially pre-picked to remove any large or rare taxa (less than 20 individuals/sample) prior to subsampling. When necessary, a Folsum sample splitter was used to subsample until a manageable number of organisms was achieved. A minimum of 250 organisms in representative proportions was removed from the fractionated samples. Qualitative samples were picked with the emphasis on removing the maximum number of taxa. Organisms from both sample types were sorted to higher taxonomic levels (generally Class or Order level) and preserved separately in labeled vials containing 70% ethyl alcohol. Sorted samples were routinely checked by senior EA personnel to assure a consistent level of quality and sorting efficiency.

Macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available. Whenever possible, the level of identifications followed those recommended by the OEPA (1988b and 2006c). Chironomidae (midge) larvae were cleared in 10% potassium hydroxide and mounted in CMC-10 on glass slides prior to identification. For both sample types, specimens were enumerated, coded and recorded on a standard laboratory bench sheet for data processing.

2.2.5 Data Analyses

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the OEPA, the ICI is a modification of the Index of Biotic Integrity for fish (OEPA 1988; DeShon 1995). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by OEPA (1988a). The sum of the individual metric scores resulted in the ICI score for that particular location.

In addition to the ICI, the benthic macroinvertebrate data were analyzed using OEPA's Qualitative Community Tolerance Values (QCTV). Unlike the more intensive ICI, which incorporates data from both an artificial substrate and qualitative sample at a given site, the QCTV uses information only from qualitative samples. The QCTV assesses the environmental tolerance or sensitivity of the macroinvertebrate community using tolerance values that are assigned to each taxon. OEPA derived these values by calculating the abundance-weighted average of all ICI scores from locations where a particular taxon was collected (DeShon 1995). Taxa that are typically abundant at least disturbed sites have a lower tolerance value while those taxa that are generally abundant at highly disturbed sites have a higher tolerance value. As such, the range of tolerance values, 0="poor" to 60="excellent", is the same as the ICI scoring range. Only taxa that are represented by five or more observations in the OEPA database are used to determine the QCTV score at a given site. The QCTV score for a given site is expressed as the median of tolerance values for all taxa observed at the site that are also represented by five or more observations in OEPA's database (Mr. Jeffrey DeShon-OEPA, pers. comm.).

In addition to the ICI and QCTV, total taxa richness, Ephemeroptera+Plecoptera+Trichoptera (EPT) richness, and the number of tolerant (moderately tolerant and tolerant) and intolerant (moderately intolerant and intolerant) taxa were used to assist the evaluation of each site.

2.3 BIOLOGICAL ASSESSMENT

Assessment of biological community health was based primarily on Ohio EPA index scores (i.e., IBI, IWBmod, and ICI scores). Comparisons were made both among sampling stations and against warmwater habitat (WWH) numeric biocriteria for the Eastern Corn Belt Plains (ECBP) ecoregion: IBI=42, IWBmod=8.5, and ICI=36. To account for biological variability, Ohio EPA considers IBI or ICI scores within 4 units of the biocriterion to meet the criterion (this is referred to as Insignificant Departure). Similarly, OEPA allows for a 0.5 unit Insignificant Departure for IWBmod scores. In this report, we followed this standard OEPA guidance in determining attainment or non-attainment of each applicable biocriterion.

In Ohio, attainment of the benthic community is typically determined by calculating the ICI. However, for the QCTV, OEPA has calculated the upper 25th percentile and lower 75th percentile of the scores for each ecoregion representing Excellent to Good sites and Fair to Poor sites, respectively. For the Eastern Corn Belt Plain (ECBP) Ecoregion, the QCTV percentile thresholds are:

Percentile	ECBP QCTV Thresholds
25th – Excellent-Good	38.70
75th – Fair-Poor	34.8

A QCTV score that exceeds the 25th percentile suggests that the site is in attainment of its WWH designated use while a QCTV score less than the 75th percentile suggests that the site is not attaining its designated use. Sites with QCTV scores that fall near these thresholds were evaluated using additional parameters to assist in determining whether the site was in attainment.

QCTV scores that clearly fall between the two thresholds were considered undetermined (Mr. Jeffrey DeShon-OEPA, pers. comm.). An area of insignificant departure has not been defined by OEPA for the QCTV.

2.4 HABITAT

Habitat was evaluated using OEPA's QHEI (Qualitative Habitat Evaluation Index) (OEPA 2006a; Rankin 1989, 1995). Methods for calculating the QHEI are described in OEPA's User Manual (OEPA 2006a) and therefore are not discussed in detail here. Principal components (metrics) that are used to develop the QHEI score are:

- substrate
- cover
- channel morphology
- riparian zone and bank erosion
- pool, riffle, run quality
- stream gradient

QHEI scores from hundreds of stream segments around the State of Ohio have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas, whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the Warmwater Habitat (WWH) biological criteria (Rankin 1995). Support or non-support is independent of water quality, i.e., even if water quality is compliant with applicable standards, a stream with QHEIs <45 usually will not support warmwater aquatic communities.

2.5 WATER QUALITY

EA collected basic water quality parameters during each fish sampling event. Concurrent with collections in each sampling zone, EA measured water temperature, dissolved oxygen, and specific conductance. In addition, EA also measured water clarity (Secchi disc reading) at each station in conjunction with the fish sampling.

3. RESULTS

3.1 FISH

The two sampling passes at the five locations yielded 5,328 fish representing 33 species and *Lepomis* hybrid (Table 1). Five intolerant species were collected: rosyface shiner, mimic shiner, black redhorse, stonecat, and banded darter. Numerically, the catch was dominated by bluntnose minnow (24 percent), spotfin shiner (16 percent), golden redhorse (10 percent), logperch and suckermouth minnow (9 percent each). No threatened or endangered species were collected during this study.

Mean species richness values declined slightly from upstream at GMRF30 (22.5 species) to downstream at GMRF20L (19.5 species) and were slightly more variable in October (18 to 23 species) than in September (20 to 23 species) with no consistent spatial patterns evident (Tables 2 and 3). Twenty-seven of the 33 species collected were represented at multiple locations whereas the following species were collected at a single location only: Mimic shiner, stonecat, rock bass (GMRF30), brook silverside (GMRF27), creek chub (GMRF25), and bluegill (GMRF20L). Mean catch rate values were also highest at GMRF30 (1,694 fish/km), declined abruptly at GMRF27 (697 fish/km), and ranged from 860 to 1,047 fish/km at the lower three zones (Tables 2 and 3). Temporally, catch rates were generally similar from September to October at all locations except at the upstream reference location, GMRF30, where catches were noticeably higher in October (2,028 fish/km) than September (1,360 fish/km).

3.2 FISH AND COMMUNITY INDICES

IBI scores at the five sampling locations in the Great Miami River are summarized below and listed in Table 4.

	IBI Scores			Narrative
Location	Sept	Oct	Avg.	Evaluation
GMRF30	44	38	41	Marg. Good
GMRF27	40	34	37	Fair
GMRF25	46	44	45	Very Good
GMRF20R	46	36	41	Marg. Good
GMRF20L	44	46	45	Very Good

IBI scores were higher in September than October at GMRF30, GMRF27, and GMRF20R and temporally similar at GMRF25 and GMRF20L. The higher IBI scores observed in September were due to moderately higher scores for a variety of metrics with few consistencies among the aforementioned three locations (Table 4).

Mean IBI scores ranged from 37 to 45 at the five locations sampled in 2007, indicating a fair to very good fish community within the study reach (OEPA 1988 and 2006b). Mean IBI scores were similar (range 41 to 45) at four of the five locations and lower at GMRF27. However, mean IBI scores at three of the four potential impact locations were greater than the upstream reference location. As a result, the mean of all potential impact locations (IBI=42) was nearly identical to the upstream reference location (IBI=41).

The lower mean IBI score observed at GMRF27 was primarily due to comparatively poor scores for the following proportion metrics: percent tolerant species, percent simple lithophiles, and percent DELT anomalies. For example, GMRF27 scored a 1 or 3 for all of the aforementioned three metrics compared to 3s and 5s scored at the other four locations (Table 4). In addition, GMRF27 scored poorly (metric score of 1 for both trips) for the percent round-bodied suckers metric, which is not surprising given the absence of riffle/run habitat and the relatively poor substrate quality at this location as discussed in more detail below. What is surprising is that the upstream reference location, which is much shallower on average and contains high quality riffle/run habitat, scored as poorly as GMRF27 for this metric (Table 4).

Percent DELT anomalies were generally low (range 0.0 to 1.1 percent) at the five locations sampled in 2007, scoring a 3 or a 5 for this metric at all locations during both trips (Table 4). The DELT affliction rate among potential impact locations (mean 0.5 percent) was slightly higher, but comparable to, the upstream reference location (0.2 percent). Common causes of DELT anomalies include the effects of bacterial, viral, fungal, and parasitic infections, neoplastic diseases, and chemicals (OEPA 1988). OEPA considers percent DELTs to be the most accurate indicator of complex toxics, with DELTs in such cases often in the range of 10 to 20% (Yoder and Rankin 1995). The fact that the DELT affliction rates among locations adjacent to the AK Steel Hamilton Site were typically <1 percent suggests that complex toxics are likely not a factor since afflication rates indicative of a response are typically an order of magnitude higher than what was observed during 2007.

IWBmod scores are summarized below and listed in Table 5.

	IWBmod Scores			Narrative
Location	Sept	Oct	Avg.	Evaluation
GMRF30	9.8	9.5	9.7	Exceptional
GMRF27	8.2	7.9	8.0	Marg. Good
GMRF25	9.2	9.9	9.5	Very Good
GMRF20R	8.6	8.9	8.7	Good
GMRF20L	9.2	9.1	9.2	Very Good

Mean IWBmod scores ranged from 8.0 to 9.7 and indicated a marginally good to exceptional fish community in this portion of the Great Miami River, based on OEPA narrative ranges (OEPA 1988 and 2006b). Mean IWBmod scores were highest at the upstream reference site, lowest immediately downstream at GMRF27, and intermediate at the lower three locations. IWBmod scores were generally similar in September and October, except at GMRF25, which exhibited a higher score in October than September.

Differences in species richness, CPEs, and community indices appear to be related to habitat quality. As discussed in Section 3.3, habitat quality likely affected the distribution of fishes, particularly at the furthest upstream two sites. For example, GMRF27 received the lowest QHEI score, lacks riffle/run habitat, and clearly contained the poorest substrate quality based on the substrate metric. Therefore, it is not surprising that this zone had the lowest mean IBI, IWBmod, and catch rates among all zones. Consistent with the poor substrate quality and lack of riffle/run habitat at GMRF27 was the lower abundance of species preferring such habitats (e.g., darters, round body suckers, and suckermouth minnow). Conversely, GMRF30 had the best habitat, particularly regarding substrate quality, channel morphology, and riffle/run quality and this location had the highest mean catch rate, species richness, and IWBmod value of all zones. In addition, the mean IBI score at GMRF30 was second only to GMRF25 and GMRF20L, which contained the second and third best habitats, respectively, based on QHEI scores. Collectively, these data suggest that habitat quality was a primary contributing factor to the variability in species composition, catch rates, and community indices observed throughout the study area.

3.2 MACROINVERTEBRATES

HD samplers were deployed at 11 locations throughout the study area. Samplers were successfully retrieved from nine of the 11 locations. At GMRSD28, no part of the sampler array was observed during retrieval. Given the moderate to fast current velocity and predominantly unconsolidated gravel substrate, it is likely that both sets of HDs were washed into the portion of the channel where it was too deep to wade. At GMRSD27, where the samplers had been set from boat at mid-channel and anchored to shore, the anchor lines had been cut and the samplers were found downstream on shore suggesting that they had been vandalized. Set and retrieval conditions for the HD samplers were as follows:

Location	Set		Retrieve		Comments
	Depth (ft)	Velocity (ft/s)	Depth (ft)	Velocity (ft/s)	
GMRSD30	1.9	0.46	1.6	0.52	
GMRSD29	1.1	1.35	0.9	1.65	
GMRSD28	1.8	1.00	--	--	Both sets missing; likely wash-out
GMRSD27	7.5	1.50	--	--	Both sets missing; ropes cut; vandalized?
GMRSD26	2.1	0.26	1.4	0.24	Both sets moved downstream; A on side
GMRSD25	1.8	0.31	1.6	0.39	
GMRSD24	1.4	0.91	1.1	1.47	B with one HD crushed. Both moved downstream.
GMRSD22	1.8	1.93	1.5	2.63	Both moved downstream 3-5 ft.
GMRSD21	2.0	0.04	1.9	0.02	B missing; A moved downstream 3-5 ft.
GMRSD20	6.0	0.30	5.8	0.33	
GMRSD23	6.0	0.24	5.8	0.22	

OEPA guidance states that besides water quality, current velocity is likely the next most important factor in determining the benthic taxa and density on HD samplers (OEPA 1988). OEPA methods recommend that the samplers should be set in current velocity of at least 0.3 ft/s (OEPA 1988). Since the HD samplers were often co-located with previously determined areas of concern, OEPA's velocity recommendation was not always a primary consideration when the sampling locations were determined for this study. Nonetheless, the minimum recommended current velocity was met at all but GMRSD26, 21, and 23. Of these three locations, the velocities measured at GMRSD26 and 23 were slightly less than the recommended minimum of 0.3 ft/s while the current velocity at GMRSD21 fell well short of this threshold.

Among the 11 locations and sampling types combined, 101 macroinvertebrate taxa were collected during the 2007 survey (Table 6). Chironomidae was the most taxa rich group among the locations with 23 taxa followed by Ephemeroptera (17 taxa), Trichoptera (12 taxa), and Coleoptera (10 taxa). Overall, total taxa richness among the HD samples ranged from 27 taxa at GMRSD21 and 23 to 21 taxa at GMRSD26 (Table 7). Qualitative total richness among the 11 locations ranged from 50 taxa at GMRSD30 to 26 taxa at GMRSD28 (Table 8).

Between the HD and qualitative samples, EPT richness was similar among most locations with 10-15 EPT taxa being observed. EPT richness in the HD samples ranged from 15 taxa at GMRSD22 to 6 taxa at GMRSD26 and 21 (Table 7). In the qualitative samples, EPT richness ranged from 15 taxa at GMRSD24 to four taxa at GMRSD20 (Table 8). These data suggest a strong relationship between habitat and EPT richness in that GMRSD22 and 24 were riffle/run locations with moderate to fast velocity and had the highest EPT richness. In contrast, GMRSD26, 21, and 20 were pool/glide locations with slow current velocity and had the lowest EPT richness.

Numerically, the benthic community was dominated by two EPT taxa, *Tricorythodes* and/or *Cheumatopsyche* at six of the nine HD locations where they comprised between 59-73% of the total organisms (Table7). The only exceptions to this were at the slow-water, pool/glide locations GMRSD26, 21, and 23, where the moderately tolerant midge *Glyptotendipes* (Table 6) was numerically dominant. However, even at GMRSD23, the moderately intolerant *Tricorythodes* was the second most abundant taxon in the HD sample.

ICI scores were calculated for nine of the 11 macroinvertebrate locations with both HD and qualitative sample results. Due to the loss of HD samples at GMRSD28 and 27, the median QCTV was determined to evaluate the benthic community. As with EPT richness, ICI scores at most locations were similar (Table 9). Among the nine locations, ICI scores ranged from 50 at GMRSD29 to 24 at GMRSD21. Of the nine locations, six clearly attained the WWH ICI biocriterion of 36 with scores in the "very good" to "excellent" narrative range (OEPA 2006b). A seventh location downstream of the AK Steel Hamilton Site, GMRSD23, achieved the biocriterion via Insignificant Departure (OEPA 1988). In contrast, ICI scores from GMRSD26 and 21 rated "fair" and did not attain the established biocriterion. Among the ten ICI metrics, both locations exhibited similarly poor results for three of the metrics: Number of Mayfly Taxa, Number of Caddisfly Taxa, and Percent Other. Although the data from locations GMRSD26 and 21 may suggest impairment, it is important to note that the samplers at both locations had been disturbed during the colonization period as indicated in the table above. Furthermore, current velocity at the two stations was among the lowest measured in the study area. As such, it appears that multiple factors may have contributed to the lower ICI scores at these locations.

ICI scores were not calculated for GMRSD28 and 27. However, the median QCTV for each location was greater than the 25th percentile of "good" to "excellent" ICI sites (Table 9). In addition, there were twice as many intolerant taxa compared to tolerant taxa at GMRSD28 and 27; nine versus four and twelve versus six, respectively (Tables 6 and 8). These results strongly suggest that the ICI biocriterion for the ECBP ecoregion was being achieved (DeShon 1995).

In general, the benthic macroinvertebrate community in the study area met or exceeded the ecoregional reference condition as defined by the ICI. The poorer quality benthic communities observed at GMRSD26 and 21 appear to be attributable, at least in part, to habitat constraints associated with velocity. The moderately tolerant midge, *Glyptotendipes* was the most abundant taxon at both locations. However, *Glyptotendipes* is not necessarily tolerant of toxic stressors, but is considered tolerant of organic/nutrient loading and associated dissolved oxygen impacts (Yoder and Rankin 1995; Yoder and DeShon 2003). Furthermore, *Glyptotendipes* is often associated with slow current habitats (Epler 2001). Pollution sensitive EPT taxa generally prefer areas with good exchange associated with flow and clean substrate. As indicated previously, GMRSD26 and 21 are in largely pool/glide areas with slow current velocity and finer substrate. Given these conditions and the fact that current velocity is vital to the collection of consistently good HD results (OEPA 1988), it is not surprising that the scores from these locations did not attain the ICI biocriterion.

3.3 HABITAT

QHEI scores are summarized in Table 10. Overall, the habitat quality was fair to excellent at the five locations sampled in 2007. Habitat quality was highest at the furthest upstream location GMRF30 (QHEI score 83.0), intermediate at GMRF20L and GMRF25 (QHEI scores of 69.0 and 72.5, respectively), and lower at GMRF27 and GMRF20R (QHEI scores of 61.0 and 62.5, respectively). Nearly all metric scores were higher at GMRF30 than at the other four locations, especially for the substrate and riffle/run metrics (Table 10). In particular, GMRF30 contained more, larger and hard substrate (i.e., boulder and cobble) with less silt. In addition, GMRF30 and 25 were the only sampling zones with at least one well defined riffle/run complex. As a result, species that require clean, hard, substrates with well developed riffles and runs (most darter species and suckermouth minnow) were more abundant at GMRF30 and GMRF25 than elsewhere. In contrast, substrate quality at GMRF27 was comparatively poor and was dominated by silt and gravel substrate types, which contributed greatly to the lower QHEI score there (Table 10). Other metrics which contributed to the comparatively poor QHEI score at GMRF27 include channel, riparian, and riffle/run quality. Overall, the two furthest downstream zones, GMRF20L and GMRF20R, contained similar habitat quality. However, instream cover was decidedly better at GMRF20L (Table 10). In fact, the cover score at GMRF20L was higher than any other zone and likely contributed substantially to the better index scores there. As such, species that prefer an abundance of instream cover (e.g., centrarchids) were substantially more abundant there than elsewhere.

3.4 WATER QUALITY

Water temperature, dissolved oxygen (DO), specific conductance, and water clarity (i.e., Secchi reading) were measured at each location concurrent with fish sampling.

Water temperatures ranged from 17.9 to 27.1 C (Table 11). Temporal changes in water temperature conformed to expected patterns; on average, water temperatures were 5.3 C cooler in October than in September 2007. Spatially, water temperatures were generally warmer (2.0 to 4.0 C) upstream than downstream (Table 11). These temperature differences were likely due to diel effects rather than a real longitudinal temperature change. For example, the upstream reference location was consistently sampled during early-mid afternoon (1205-1444 hours), whereas the furthest downstream locations were sampled during mid-morning (0918 and 1015 hours). Nonetheless, water temperatures at all stations were within ranges easily tolerated by warmwater fishes.

DO values ranged from 6.6 to 14.1 mg/l during the 2007 study (Table 11). On average, DO values were higher in September (11.9 mg/l) than in October (9.8 mg/l). DO values were consistently higher at the upper three sites (range 10.5 to 14.1 mg/l) compared to the lower two sites (6.6 to 8.9 mg/l). These differences were most pronounced between GMRF25 and the lower two locations (i.e., GMRF20R and GMRF20L) where DO values declined by 11.5 mg/l (September) and 4.7 (October). All DO concentrations met the minimum WWH criterion of 4 ppm during each sampling event.

Specific conductance values and Secchi readings varied little spatially and temporally and ranged from 896 to 962 µScm and from 43 to 66 cm, respectively (Table 11).

4. ASSESSMENT

Community index scores, QHEI scores, and applicable ecoregion biocriteria values are summarized in Table 12. For the purposes of biological assessment and determination of attainment of warmwater habitat (WWH) biocriteria, locations were grouped into four distinct sampling areas (containing at least one fish and one macroinvertebrate sampling location), based on proximity to one another. The four sampling areas include the upstream reference location (containing GMRF30, GMRSD30, 29, and 28) and three areas adjacent to and/or downstream of the AK Steel Hamilton Site: upper (GMRF27 and GMRSD27), middle (GMRF25 and GMRSD26, 25, 24, and 22), and lower (GMRF20R, GMRF20L, and GMRSD21, 20, and 23). Due to the fact that there were two fish sampling passes and multiple benthic sampling locations were often paired with a single fish location, attainment of the applicable biocriteria values was determined based on the average index scores within a given area. However, due to the severe flow related constraints described in Section 3.2, the benthic macroinvertebrate data from GMRSD21 were not incorporated in the attainment evaluation for the lower portion of the study area.

All IBI and IWBmod WWH criteria were attained at the sampling locations, except at GMRF27, where the IBI failed to attain the criterion of 42 (Table 12). Although GMRF27 met the IBI criterion in September (40), with Insignificant Departure (see Section 2.4), the considerably lower IBI score in October (34) resulted in non-attainment of the IBI at this location (Table 4). However, the lower IBI score at GMRF27 in October was mirrored at the upstream reference location (GMRF30) where the IBI also dropped by 6 points from September to October (Table 4). As such, attainment of the IBI criterion at the upstream reference location, GMRF30, was achieved only when considering Insignificant Departure (Table 12).

Except for GMRSD26 and 21, all remaining benthic macroinvertebrate sampling locations either actually attained the ICI biocriterion or the results suggested that attainment was achieved via the median QCTV (Table 12). In addition, collectively, the benthic community attained or suggested attainment in each of the four primary study areas (Table 12).

OEPA has evaluated criteria associated with biological response signature identification (Yoder and Rankin 1995; Yoder and DeShon 2003). Although bioassessment is not diagnostic to the extent that specific impairments can be readily attributed to specific causative factors, patterns have been identified in fish and benthic communities that apply to broad categories of impairment such as, Complex Toxic, Channelization, Agricultural Non-point Source, and Organic/Nutrient impacts (Yoder and Rankin 1995).

Criteria Used to Determine the Extent of a Response Signature Exhibited by a Fish Assemblage - Boat Sites (Yoder and DeShon 2003)

Metrics	Criteria	GMRF27 (mean)
IBI Score	≤22	37
IWBmod Score	≤5.9	8.0
% DELT Anomalies	≥10	1
% Tolerant	≥70	29
Number of Intolerant Species	<1	2
Density (less Tolerants)	<150	499
% Round-Bodied Suckers	<5	8.2

Yoder and DeShon (2003) found that exceeding six of seven above designated fish community thresholds was indicative of a strong toxic response. However, results from the only zone that did not attain the fish biocriteria during the study, GMRF27, indicate no such relationship exists. This suggests that toxic impairment was not a limiting factor or the cause of the lower observed index scores at GMRF27.

Criteria Used to Determine the Extent of a Response Signature Exhibited by Benthic Assemblages (Yoder and DeShon 2003)

Metrics	Criteria	GMRSD26	GMRSD21
ICI Score	≤18	26	24
Qualitative EPT Richness	≤4	9	10
% *Cricotopus* sp.	≥5	3	0
% Toxic-Tolerant Taxa	≥35	4	1
% Organic/Nutrient/DO Tolerant Taxa	≥35	47	89

Yoder and DeShon (2003) demonstrated that exceeding just three of the above macroinvertebrate thresholds strongly suggests complex toxic impairment. As with the fish community analysis, results from the only two locations that did not attain the ICI biocriterion, GMRSD26 and 21, exhibit no such relationship. These results do suggest the presence of impacts related to organic/nutrient loading as evidenced by the higher values for Percent Organic/Nutrient/DO Tolerant taxa at GMRSD26 and 21. However, it is unlikely that impacts of this nature are related to the AK Steel Hamilton Site. On the contrary, impacts associated with organic/nutrient loading are likely attributable to urban and agricultural land uses in the watershed and possibly the pooled nature of the habitat at these two locations.

Collectively, any effects of the AK Steel Hamilton Site appear to have little or no impact on the aquatic community in adjacent portions of the Great Miami River. This was demonstrated by the fact mean IBI, IWBmod, ICI and median QCTV scores among all potential impact locations attained or suggested attainment of the established biocriteria. Although observed upstream habitat seemed more ecologically desirable when compared to adjacent and downstream locations (Table 10), index scores were generally similar to the upstream reference site (Table 12). In addition, based on mean IBI and IWBmod scores and actual ICI scores, the fish and benthic communities at two of the four potential impact locations (GMRF25 and GMRF20L) met the narrative classification for very good (OEPA 2006b) and met all **exceptional** warmwater habitat (EWH) biocriteria.

5. CONCLUSION

During September and October 2007, fish and macroinvertebrates were sampled at multiple locations in the Great Miami River using standard Ohio EPA sampling protocols and according to procedures outlined in the Ohio EPA approved "Ecological Risk Assessment Supplemental Work Plan for the Former Armco Hamilton Plant Site" (ENSR 2007). Three biological indices were calculated to evaluate the fish and benthic communities: Index of Biotic Integrity (IBI), Modified Index of Well-Being (IWBmod), and Invertebrate Community Index (ICI). The community specific data, index scores, associated Qualitative Habitat Evaluation Index (QHEI) results, and other habitat observations indicate that the former ARMCO Hamilton plant site does not adversely affect the biological communities in adjacent and downstream portions of the Great Miami River. Ohio EPA review of the workplan for this effort resulted in approval for AK Steel to "consider a "no effects" survey result as an off-ramp to further investigation of the Great Miami River for this site" (OEPA 2007). Based on the results contained within this report, no further investigation of the Great Miami River is warranted to evaluate ecological impact to the river from the site under CERCLA and the NCP.

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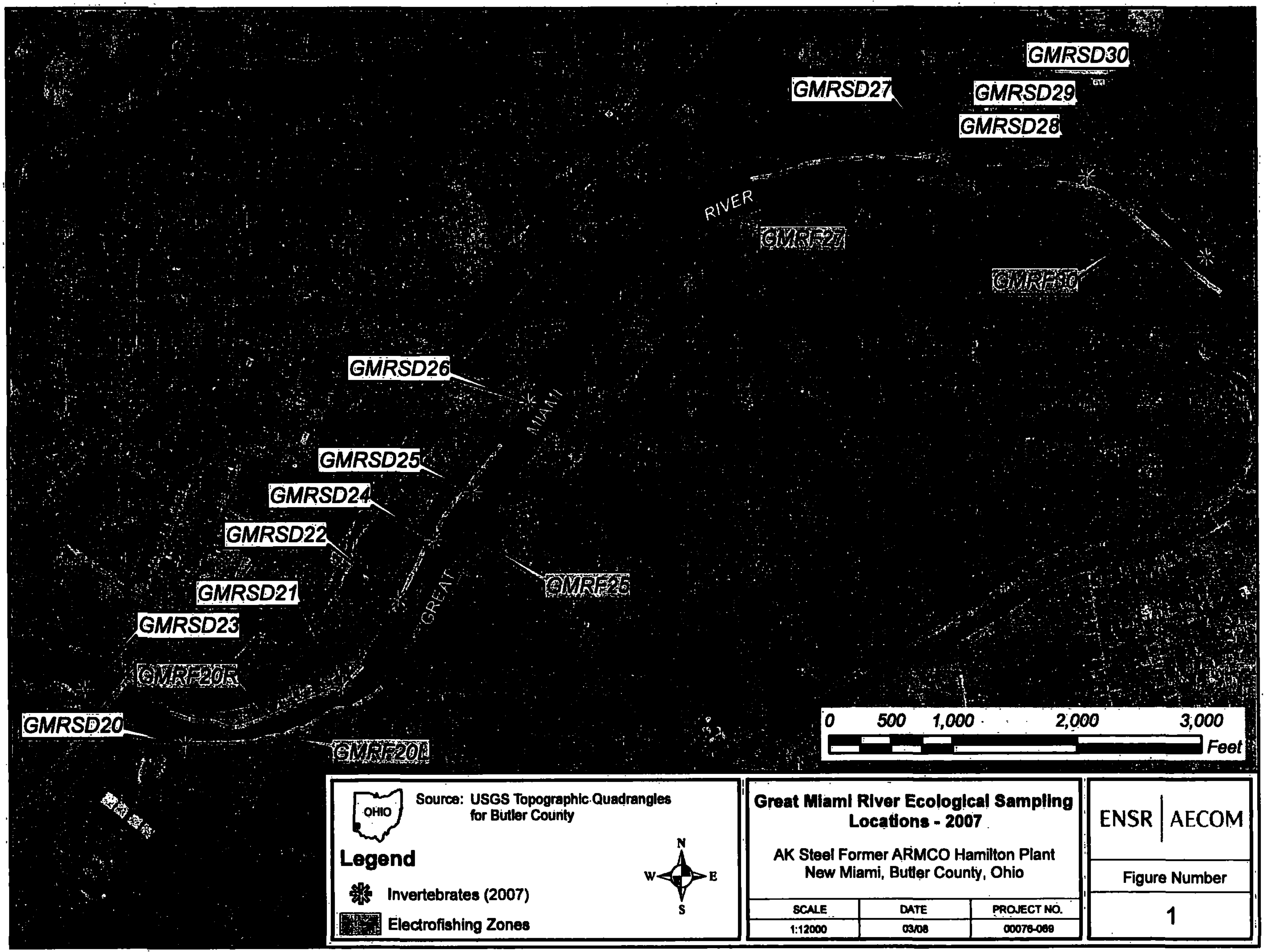
FIGURES



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TABLES

Table 1. Number and Relative Abundance of Fishes Collected from the Great Miami River near the AK Steel Hamilton Site, September and October 2007.

Common Family Name	Common Name	Scientific Name	No.	%
HERRINGS	GIZZARD SHAD	*Dorosoma cepedianum*	10	0.19
CARPS AND MINNOWS	CENTRAL STONEROLLER	*Campostoma anomalum*	73	1.37
	COMMON CARP	*Cyprinus carpio*	71	1.33
	STRIPED SHINER	*Luxilus chrysocephalus*	17	0.32
	ROSYFACE SHINER	*Notropis rubellus*	205	3.85
	SPOTFIN SHINER	*Cyprinella spiloptera*	878	16.48
	SAND SHINER	*Notropis stramineus*	138	2.59
	MIMIC SHINER	*Notropis volucellus*	3	0.06
	SUCKERMOUTH MINNOW	*Phenacobius mirabilis*	471	8.84
	BLUNTNOSE MINNOW	*Pimephales notatus*	1,293	24.27
	CREEK CHUB	*Semotilus atromaculatus*	1	0.02
SUCKERS	RIVER CARPSUCKER	*Carpiodes carpio*	2	0.04
	QUILLBACK	*Carpiodes cyprinus*	33	0.62
	NORTHERN HOG SUCKER	*Hypentelium nigricans*	157	2.95
	SMALLMOUTH REDHORSE	*Moxostoma breviceps*	219	4.11
	BLACK REDHORSE	*Moxostoma duquesnei*	3	0.06
	GOLDEN REDHORSE	*Moxostoma erythrurum*	533	10.00
NORTH AMERICAN CATFISHES	CHANNEL CATFISH	*Ictalurus punctatus*	73	1.37
	STONECAT	*Noturus flavus*	2	0.04
	FLATHEAD CATFISH	*Pylodictis olivaris*	32	0.60
NEW WORLD SILVERSIDES	BROOK SILVERSIDE	*Labidesthes sicculus*	1	0.02
SUNFISHES	ROCK BASS	*Ambloplites rupestris*	1	0.02
	GREEN SUNFISH	*Lepomis cyanellus*	23	0.43
	ORANGESPOTTED SUNFISH	*Lepomis humilis*	16	0.30
	BLUEGILL	*Lepomis macrochirus*	12	0.23
	LONGEAR SUNFISH	*Lepomis megalotis*	139	2.61
	Lepomis HYBRID	*Lepomis* HYBRID	4	0.08
	Lepomis sp.	*Lepomis* sp.	1	0.02
	SMALLMOUTH BASS	*Micropterus dolomieu*	117	2.20
	LARGEMOUTH BASS	*Micropterus salmoides*	51	0.96
PERCHES	GREENSIDE DARTER	*Etheostoma blennioides*	82	1.54
	RAINBOW DARTER	*Etheostoma caeruleum*	3	0.06
	BANDED DARTER	*Etheostoma zonale*	158	2.97
	LOGPERCH	*Percina caprodes*	494	9.27
	BLACKSIDE DARTER	*Percina maculata*	12	0.23
		Total Fish	5,328	100.00
		Total Species	33	

Table 2. Number, CPE (No. per Km), and Relative Abundance of Fishes Collected at each Sampling Location in the Great Miami River near the AK Steel Hamilton Site, September 2007.

Species	GMRF30			GMRF27			GMRF25			GMRF20R			GMRF20L		
	No.	CPE	%	No.	CPE	%	No.	CPE	%	No.	CPE	%	No.	CPE	%
GIZZARD SHAD	1	2	0.1	--	--	--	--	--	--	1	2	0.2	--	--	--
CENTRAL STONEROLLER	14	28	2.1	1	2	0.3	4	8	0.9	15	30	3.5	1	2	0.2
COMMON CARP	5	10	0.7	10	20	2.7	10	20	2.2	1	2	0.2	6	12	1.3
STRIPED SHINER	--	--	--	1	2	0.3	1	2	0.2	9	18	2.1	--	--	--
ROSYFACE SHINER	30	60	4.4	2	4	0.5	15	30	3.3	8	16	1.9	8	16	1.8
SPOTFIN SHINER	93	186	13.7	144	288	38.3	51	102	11.2	22	44	5.1	55	110	12.2
SAND SHINER	41	82	6.0	1	2	0.3	5	10	1.1	13	26	3.0	--	--	--
MIMIC SHINER	2	4	0.3	--	--	--	--	--	--	--	--	--	--	--	--
SUCKERMOUTH MINNOW	49	98	7.2	9	18	2.4	73	146	16.0	13	26	3.0	11	22	2.4
BLUNTNOSE MINNOW	159	318	23.4	90	180	23.9	36	72	7.9	90	180	20.9	78	156	17.3
QUILLBACK	13	26	1.9	1	2	0.3	1	2	0.2	3	6	0.7	4	8	0.9
NORTHERN HOG SUCKER	27	54	4.0	--	--	--	29	58	6.3	13	26	3.0	2	4	0.4
SMALLMOUTH REDHORSE	16	32	2.4	8	16	2.1	54	108	11.8	19	38	4.4	37	74	8.2
GOLDEN REDHORSE	28	56	4.1	24	48	6.4	39	78	8.5	112	224	26.0	112	224	24.8
CHANNEL CATFISH	8	16	1.2	2	4	0.5	17	34	3.7	--	--	--	7	14	1.5
STONECAT	2	4	0.3	--	--	--	--	--	--	--	--	--	--	--	--
FLATHEAD CATFISH	4	8	0.6	13	26	3.5	--	--	--	2	4	0.5	2	4	0.4
GREEN SUNFISH	--	--	--	4	8	1.1	--	--	--	--	--	--	12	24	2.7
ORANGESPOTTED SUNFISH	1	2	0.1	2	4	0.5	5	10	1.1	1	2	0.2	1	2	0.2
BLUEGILL	--	--	--	1	2	0.3	1	2	0.2	--	--	--	7	14	1.5
LONGEAR SUNFISH	1	2	0.1	25	50	6.6	4	8	0.9	5	10	1.2	30	60	6.6
Lepomis HYBRID	--	--	--	--	--	--	--	--	--	1	2	0.2	1	2	0.2
Lepomis sp.	--	--	--	1	2	0.3	--	--	--	--	--	--	--	--	--
SMALLMOUTH BASS	8	16	1.2	5	10	1.3	4	8	0.9	9	18	2.1	17	34	3.8
LARGEMOUTH BASS	--	--	--	6	12	1.6	--	--	--	15	30	3.5	15	30	3.3
GREENSIDE DARTER	33	66	4.9	1	2	0.3	15	30	3.3	2	4	0.5	--	--	--
RAINBOW DARTER	1	2	0.1	--	--	--	--	--	--	--	--	--	--	--	--
BANDED DARTER	30	60	4.4	4	8	1.1	18	36	3.9	5	10	1.2	5	10	1.1
LOGPERCH	114	228	16.8	20	40	5.3	75	150	16.4	64	128	14.8	40	80	8.8
BLACKSIDE DARTER	--	--	--	1	2	0.3	--	--	--	8	16	1.9	1	2	0.2
Total Fish	680	1,360	100.0	376	752	100.0	457	914	100.0	431	862	100.0	452	904	100.0
Total Species	23			23			20			22			21		
IBI	44			40			46			46			44		
IWBmod	9.9			8.2			9.2			8.6			9.3		

Table 3. Number, CPE (No. per Km), and Relative Abundance of Fishes Collected at each Sampling Location in the Great Miami River near the AK Steel Hamilton Site, October 2007.

	GMRF30			GMRF27			GMRF25			GMRF20R			GMRF20L		
Species	No.	CPE	%	No.	CPE	%	No.	CPE	%	No.	CPE	%	No.	CPE	%
GIZZARD SHAD	1	2	0.1	--	--	--	--	--	--	7	14	1.2	--	--	--
CENTRAL STONEROLLER	4	8	0.4	--	--	--	28	56	4.7	6	12	1.0	--	--	--
COMMON CARP	6	12	0.6	20	40	6.2	9	18	1.5	--	--	--	4	8	1.0
STRIPED SHINER	--	--	--	--	--	--	1	2	0.2	5	10	0.8	--	--	--
ROSYFACE SHINER	68	136	6.7	6	12	1.9	4	8	0.7	61	122	10.2	3	6	0.7
SPOTFIN SHINER	173	346	17.1	116	232	36.1	46	92	7.8	101	202	16.9	77	154	18.9
SAND SHINER	16	32	1.6	1	2	0.3	1	2	0.2	56	112	9.3	4	8	1.0
MIMIC SHINER	1	2	0.1	--	--	--	--	--	--	--	--	--	--	--	--
SUCKERMOUTH MINNOW	147	294	14.5	10	20	3.1	137	274	23.2	10	20	1.7	12	24	2.9
BLUNTNOSE MINNOW	398	796	39.3	73	146	22.7	85	170	14.4	230	460	38.4	54	108	13.2
CREEK CHUB	--	--	--	--	--	--	1	2	0.2	--	--	--	--	--	--
RIVER CARPSUCKER	--	--	--	2	4	0.6	--	--	--	--	--	--	--	--	--
QUILLBACK	10	20	1.0	--	--	--	--	--	--	1	2	0.2	--	--	--
NORTHERN HOG SUCKER	27	54	2.7	1	2	0.3	43	86	7.3	14	28	2.3	1	2	0.2
SMALLMOUTH REDHORSE	18	36	1.8	1	2	0.3	34	68	5.8	11	22	1.8	21	42	5.1
BLACK REDHORSE	--	--	--	--	--	--	2	4	0.3	--	--	--	1	2	0.2
GOLDEN REDHORSE	31	62	3.1	23	46	7.2	39	78	6.6	33	66	5.5	92	184	22.5
CHANNEL CATFISH	6	12	0.6	2	4	0.6	24	48	4.1	1	2	0.2	6	12	1.5
FLATHEAD CATFISH	2	4	0.2	6	12	1.9	2	4	0.3	1	2	0.2	--	--	--
BROOK SILVERSIDE	--	--	--	1	2	0.3	--	--	--	--	--	--	--	--	--
ROCK BASS	1	2	0.1	--	--	--	--	--	--	--	--	--	--	--	--
GREEN SUNFISH	1	2	0.1	1	2	0.3	1	2	0.2	--	--	--	4	8	1.0
ORANGESPOTTED SUNFISH	--	--	--	5	10	1.6	--	--	--	1	2	0.2	--	--	--
BLUEGILL	--	--	--	--	--	--	--	--	--	--	--	--	3	6	0.7
LONGEAR SUNFISH	10	20	1.0	23	46	7.2	7	14	1.2	3	6	0.5	31	62	7.6
Lepomis HYBRID	--	--	--	--	--	--	1	2	0.2	--	--	--	1	2	0.2
SMALLMOUTH BASS	13	26	1.3	13	26	4.0	7	14	1.2	11	22	1.8	30	60	7.4
LARGEMOUTH BASS	--	--	--	1	2	0.3	--	--	--	4	8	0.7	10	20	2.5
GREENSIDE DARTER	12	24	1.2	--	--	--	19	38	3.2	--	--	--	--	--	--
RAINBOW DARTER	--	--	--	--	--	--	1	2	0.2	1	2	0.2	--	--	--
BANDED DARTER	24	48	2.4	3	6	0.9	52	104	8.8	10	20	1.7	7	14	1.7
LOGPERCH	45	90	4.4	13	26	4.0	44	88	7.5	32	64	5.3	47	94	11.5
BLACKSIDE DARTER	--	--	--	--	--	--	2	4	0.3	--	--	--	--	--	--
Total Fish	1,014	2,028	100.0	321	642	100.0	590	1,180	100.0	599	1,198	100.0	408	816	100.0
Total Species	22			20			23			21			18		
IBI	38			34			44			36			46		
IWBmod	9.5			7.9			9.9			8.9			9.1		

Table 4. IBI Metric Results and Scores for Fish Sampling Locations on the Great Miami River near the AK Steel Hamilton Site, September & October 2007.

DATE	LOCATION	GEAR	DRAINAGE AREA	TOTAL IBI SCORE	LOWEND SCORING	# SPECIES	SCORE	# SUNFISH SPECIES	SCORE	# SUCKER SPECIES	SCORE	# INTOLERANT SPP	SCORE	NONTOLERANT CPE	SCORE	% TOLERANT	SCORE	% ROUNDBODY SUCKER	SCORE	% TOP CARNIVORE	SCORE	% OMNIVORE	SCORE	% INSECTIVORE	SCORE	% LITHOPHILS	SCORE	% DELT ANOMALIES	SCORE	TOTAL CPE
6-Sep-07	GMRF30	B	3297	44		22	5	2	3	4	3	4	5	1032	5	24.1	3	10.4	1	1.8	1	26.2	3	68.8	5	48.2	5	0.1	5	1360.0
10-Oct-07	GMRF30	B	3297	38		21	5	3	3	4	3	3	3	1218	5	39.9	1	7.5	1	1.6	1	40.9	1	56.5	5	36.7	5	0.3	5	2028.0
6-Sep-07	GMRF27	B	3298	40		22	5	4	5	3	3	2	3	544	5	27.7	1	8.5	1	6.4	3	26.9	3	66.0	5	18.6	3	1.1	3	752.0
10-Oct-07	GMRF27	B	3298	34		19	3	3	3	4	3	2	3	454	5	29.3	1	7.8	1	6.2	3	29.6	1	63.6	5	17.8	3	0.9	3	642.0
6-Sep-07	GMRF25	B	3298	46		19	3	3	3	4	3	2	3	822	5	10.1	5	26.7	3	0.9	1	10.3	5	84.2	5	69.8	5	0.0	5	914.0
10-Oct-07	GMRF25	B	3298	44		22	5	2	3	4	3	3	3	986	5	16.3	3	20.0	3	1.5	1	15.9	5	73.4	5	64.1	5	0.7	3	1180.0
6-Sep-07	GMRF20R	B	3298	46		21	5	2	3	4	3	2	3	678	5	21.1	3	33.4	3	6.0	3	22.0	3	68.2	5	58.7	5	0.2	5	862.0
10-Oct-07	GMRF20R	B	3298	36		21	5	2	3	4	3	2	3	738	5	38.4	1	9.7	1	2.7	1	39.7	1	56.4	5	29.5	3	0.0	5	1198.0
7-Sep-07	GMRF20L	B	3298	44		20	3	4	5	4	3	2	3	710	5	21.2	3	33.4	3	7.5	3	19.5	3	71.0	5	47.8	5	0.9	3	904.0
11-Oct-07	GMRF20L	B	3298	46		17	3	3	3	4	3	3	3	690	5	15.2	3	28.2	3	9.8	3	14.2	5	74.3	5	45.1	5	0.2	5	816.0

Table 5: Index of Well Being (IWB & IWBmod) Metric Results and Scores for Fish Sampling Locations on the Great Miami River near the AK Steel Hamilton Site, September & October 2007.

LOCATION	METHOD	DATE	DISTANCE	IWB	IWBMOD	TOTAL COUNT	TOTAL WEIGHT	INTOLERANT COUNT	INTOLERANT WEIGHT	DIVERSITY COUNT	DIVERSITY WEIGHT
GMRF30	BOAT	6-Sep-07	500	10.13	9.85	1360	46.78	1032	35.31	2.44	2.16
GMRF30	BOAT	10-Oct-07	500	10.00	9.48	2028	60.55	1218	35.51	2.02	2.12
GMRF27	BOAT	6-Sep-07	500	8.76	8.17	752	85.07	544	36.00	2.04	1.19
GMRF27	BOAT	10-Oct-07	500	8.64	7.90	642	76.94	454	24.82	2.05	1.18
GMRF25	BOAT	6-Sep-07	500	9.47	9.16	914	37.72	822	22.35	2.49	1.75
GMRF25	BOAT	10-Oct-07	500	10.19	9.88	1180	84.73	986	54.35	2.47	1.97
GMRF20R	BOAT	6-Sep-07	500	8.98	8.57	862	14.62	678	8.14	2.35	1.91
GMRF20R	BOAT	10-Oct-07	500	9.19	8.91	1198	10.82	738	10.13	2.06	2.39
GMRF20L	BOAT	7-Sep-07	500	9.62	9.25	904	52.65	710	32.01	2.38	1.85
GMRF20L	BOAT	11-Oct-07	500	9.37	9.06	816	62.40	690	39.96	2.29	1.67

Table 6. OEPA Qualitative Community Tolerance Value (QCTV) and OEPA narrative tolerance classification for benthic macroinvertebrate taxa collected from the Great Miami River near the AK Steel Hamilton Site, September 2007(OEPA 2008).

Taxa	QCTV	Narrative Tolerance[a]	Taxa	QCTV	Narrative Tolerance
Turbellaria	28.0	F	Cheumatopsyche	43.3	F
Urnatella gracilis	36.1	F	Hydropsyche orris	44.5	MI
Plumatella	39.2	F	Hydropsyche simulans	46.6	MI
Oligochaeta	17.5	T	Hydropsyche aerata	48.2	MI
Placobdella	.	F	Hydropsyche bidens	46.7	MI
Mooreobdella microstoma	19.4	T	Ceratopsyche morosa	50.5	MI
Ostracoda	.	--	Potamyia flava	48.2	MI
Caecidotea	21.6	M	Hydroptila	42.5	F
Hyalella azteca	28.0	F	Nectopsyche candida	49.2	MI
Crangonyx	21.8	M	Oecetis	44.2	MI
Orconectes rusticus	34.7	F	Petrophila	47.8	I
Hydracarina	42.3	F	Laccophilus maculosus	13.0	T
Collembola	.	--	Dineutus	42.5	F
Isonychia	49.5	MI	Peltodytes	16.7	M
Acentrella turbida	54.4	I	Helichus	42.1	MI
Baetis intercalaris	47.1	F	Ancyronyx variegata	40.0	MI
Centroptilum	41.0	MI	Macronychus glabratus	44.5	MI
Procloeon	43.0	MI	Stenelmis	42.7	F
Callibaetis	24.8	M	Tropisternus	10.2	M
Plauditus	50.9	MI	Berosus	23.4	M
Leucrocuta	46.7	I	Enochrus	39.2	F
Heptagenia	47.8	--	Ceratopogonidae	28.1	F
Stenacron	43.2	F	Atrichopogon	38.7	F
Stenonema femoratum	43.5	F	Procladius	21.7	M
Maccaffertium pulchellum	47.6	MI	Ablabesmyia mallochi	33.7	F
Maccaffertium terminatum	46.4	MI	Labrundinia	36.0	F
Maccaffertium exiguum	48.9	I	Thienemannimyia grp.	30.0	F
Tricorythodes	45.2	MI	Cricotopus bicinctus grp.	24.8	M
Caenis	42.6	F	Nanocladius distinctus	24.6	M
Anthopotamus myops	42.5	MI	Nanocladius crassicornus/rectinervis	39.5	F
Hetaerina	44.6	F	Chironomus	39.7	T
Argia	33.7	F	Cryptochironomus	33.6	F
Enallagma	.	--	Dicrotendipes neomodestus	34.3	F
Boyeria vinosa	41.0	F	Dicrotendipes simpsoni	16.5	T
Aeshna	29.8	F	Glyptotendipes	21.3	M
Gomphus	45.9	F	Parachironomus	37.0	F
Epitheca princeps	12.4	T	Parachironomus frequens	37.0	F
Belostoma flumineum	.	F	Phaenopsectra obediens grp.	36.4	F
Palmacorixa	24.7	F	Polypedilum flavum	39.9	F
Trichocorixa	38.4	F	Polypedilum halterale grp.	33.4	F
Ranatra	.	F	Polypedilum illinoense	17.6	T
Corydalus cornutus	47.1	MI	Polypedilum scalaenum grp.	29.3	F
Sialis	30.0	T	Pseudochironomus	31.5	F
Chimarra obscura	46.4	MI	Rheotanytarsus	44.2	MI
Cyrnellus fraternus	29.3	F	Tanytarsus glabrescens grp.	41.1	F

Table 6 (cont.)

Taxa	QCTV	Narrative Tolerance
Tanytarsus guerlus grp.	41.9	MI
Simulium	34.8	F
Ephydridae	38.3	F
Elimia	38.4	MI
Fossaria	29.7	F
Physa	16.5	T
Helisoma	28.7	M
Menetus	14.4	T
Ferrissia	33.7	F
Corbicula fluminea	37.6	MI
Musculium	38.2	--

[a]I=Intolerant, MI=Moderately Intolerant, F=Facultative, M=Moderately Tolerant, and T=Tolerant.

Table 7. The Composition, Number, and Relative Abundance of Benthic Macroinvertebrates Occurring on Hester-Dendy Samplers from the Great Miami River near the AK Steel Hamilton Site, September 2007.

	GMRSD30		GMRSD29		GMRSD26		GMRSD25		GMRSD24		GMRSD22		GMRSD21		GMRSD20		GMRSD23	
TAXA	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Turbellaria	266	1.81	339	2.83	124	4.69	175	2.98	793	6.25	2,319	11.93	427	4.94	82	0.64	–	–
Plumatella	1	0.01	1	0.01	1	0.04	1	0.02	1	0.01	1	0.01	1	0.01	1	0.01	1	0.02
Oligochaeta	–	–	–	–	44	1.66	1	0.02	–	–	–	–	7	0.08	4	0.03	–	–
Ostracoda	–	–	–	–	44	1.66	–	–	–	–	–	–	–	–	–	–	–	–
Isonychia	1	0.01	71	0.59	–	–	2	0.03	141	1.11	17	0.09	–	–	8	0.06	1	0.02
Acentrella turbida	–	–	129	1.08	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Baetis intercalaris	4	0.03	531	4.43	–	–	2	0.03	268	2.11	29	0.15	–	–	2	0.02	1	0.02
Plauditus	–	–	–	–	–	–	–	–	–	–	1	0.01	–	–	–	–	–	–
Procloeon	1	0.01	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Maccaffertium exiguum	66	0.45	65	0.54	–	–	5	0.09	4	0.03	3	0.02	–	–	108	0.84	34	0.82
Maccaffertium pulchellum	10	0.07	12	0.10	2	0.08	34	0.58	140	1.10	17	0.09	4	0.05	281	2.19	133	3.21
Maccaffertium terminatum	260	1.77	70	0.58	20	0.76	72	1.22	265	2.09	7	0.04	–	–	498	3.89	87	2.10
Stenacron	137	0.93	–	–	252	9.53	301	5.12	268	2.11	1	0.01	285	3.30	288	2.25	377	9.11
Tricorythodes	7,311	49.83	3,465	28.92	241	9.11	2,002	34.05	1,872	14.76	2,179	11.21	87	1.01	4,891	38.18	765	18.49
Caenis	–	–	–	–	–	–	–	–	–	–	–	–	75	0.87	4	0.03	–	–
Hetaerina	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0.02
Argia	2	0.01	–	–	2	0.08	2	0.03	2	0.02	–	–	5	0.06	–	–	1	0.02
Enallagma	–	–	–	–	–	–	–	–	–	–	–	–	5	0.06	–	–	1	0.02
Chimarra obscura	–	–	–	–	–	–	–	–	1	0.01	–	–	–	–	–	–	–	–
Cyrnellus fraternus	9	0.06	–	–	551	20.83	80	1.36	2	0.02	1	0.01	35	0.40	200	1.56	735	17.77
Ceratopsyche morosa	205	1.40	460	3.84	–	–	2	0.03	132	1.04	1,032	5.31	–	–	32	0.25	1	0.02
Cheumatopsyche	3,353	22.85	3,606	30.10	35	1.32	1,561	26.55	6,098	48.07	10,528	54.17	4	0.05	4,450	34.74	436	10.54
Hydropsyche aerata	390	2.66	1,232	10.28	–	–	166	2.82	528	4.16	1,165	5.99	–	–	66	0.52	–	–
Hydropsyche bidens	–	–	–	–	–	–	–	–	–	–	1	0.01	–	–	–	–	–	–
Hydropsyche orris	384	2.62	515	4.30	–	–	32	0.54	5	0.04	779	4.01	–	–	225	1.76	–	–
Potamyia flava	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32	0.25	–	–
Hydroptila	–	–	–	–	–	–	–	–	–	–	1	0.01	–	–	–	–	–	–
Petrophila	–	–	3	0.03	–	–	–	–	131	1.03	–	–	–	–	–	–	–	–
Ancyronyx variegata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8	0.06	–	–
Macronychus glabratus	–	–	–	–	–	–	1	0.02	–	–	–	–	1	0.01	7	0.05	1	0.02
Stenelmis	–	–	2	0.02	–	–	–	–	–	–	4	0.02	–	–	–	–	–	–
Berosus	–	–	–	–	–	–	–	–	–	–	–	–	1	0.01	–	–	–	–
Ablabesmyia mallochi	–	–	–	–	–	–	–	–	–	–	–	–	64	0.74	–	–	–	–
Labrundinia	–	–	–	–	–	–	–	–	–	–	–	–	64	0.74	–	–	13	0.31
Thienemannimyia grp.	432	2.94	136	1.14	24	0.91	40	0.68	128	1.01	75	0.39	–	–	395	3.08	243	5.87
Cricotopus bicinctus grp.	–	–	88	0.73	72	2.72	72	1.22	96	0.76	85	0.44	–	–	–	–	–	–
Nanocladius crassicornus/rectinervis	112	0.76	88	0.73	40	1.51	56	0.95	224	1.77	139	0.72	128	1.48	85	0.66	90	2.18
Nanocladius distinctus	160	1.09	32	0.27	40	1.51	88	1.50	16	0.13	64	0.33	64	0.74	53	0.41	115	2.78
Dicrotendipes neomodestus	–	–	–	–	40	1.51	–	–	16	0.13	–	–	448	5.18	–	–	13	0.31

Table 7 (cont.)

TAXA	GMRSD30		GMRSD29		GMRSD26		GMRSD25		GMRSD24		GMRSD22		GMRSD21		GMRSD20		GMRSD23	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Glyptotendipes	848	5.78	88	0.73	1,016	38.41	376	6.39	96	0.76	11	0.06	6,848	79.21	512	4.00	781	18.88
Parachironomus frequens	16	0.11	16	0.13	–	–	–	–	–	–	–	–	–	–	85	0.66	13	0.31
Polypedilum flavum	368	2.51	456	3.81	40	1.51	232	3.95	592	4.67	480	2.47	64	0.74	96	0.75	64	1.55
Polypedilum scalaenum grp.	–	–	–	–	16	0.60	–	–	–	–	–	–	–	–	–	–	–	–
Rheotanytarsus	320	2.18	576	4.81	40	1.51	576	9.80	864	6.81	235	1.21	–	–	395	3.08	230	5.56
Tanytarsus glabrescens grp.	16	0.11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Elimia	1	0.01	–	–	1	0.04	–	–	3	0.02	3	0.02	15	0.17	–	–	–	–
Physa	–	–	–	–	–	–	1	0.02	–	–	–	–	9	0.10	1	0.01	–	–
Menetus	–	–	–	–	–	–	–	–	–	–	–	–	2	0.02	–	–	–	–
Ferrissia	–	–	–	–	–	–	–	–	–	–	–	–	2	0.02	–	–	–	–
Musculium	–	–	1	0.01	–	–	–	–	–	–	259	1.33	–	–	–	–	–	–
TOTAL	14,673	100	11,982	100	2,645	100	5,880	100	12,686	100	19,436	100	8,645	100	12,809	100	4,137	100
Total Taxa Richness	25		24		21		25		26		24		27		24		27	
EPT Richness	13		11		6		12		13		15		6		14		10	

Table 8. The Composition and Assigned Abundance[1] of Benthic Macroinvertebrates Collected from Natural Substrates in the Great Miami River near the AK Steel Hamilton Site, September 2007.

TAXA	GMRSD 30 A	GMRSD 29 A	GMRSD 28 A	GMRSD 27 A	GMRSD 26 A	GMRSD 25 A	GMRSD 24 A	GMRSD 22 A	GMRSD 21 A	GMRSD 20 A	GMRSD 23 A
Turbellaria	3	10	3	10	3	10	10	10	10	3	3
Urnatella gracilis					1				1	1	
Plumatella	1	1	1	1	1	1	1	1	1	1	1
Oligochaeta	10	3		3	10	10	3	10	10	3	3
Placobdella					3	1	1		1	3	3
Mooreobdella microstoma										1	
Ostracoda	10	3		3	10	3	3	3	3	3	3
Caecidotea	3				1	3				3	1
Hyalella azteca	10	1			3	1	3	10		10	10
Crangonyx	3				3					3	
Orconectes rusticus				3	3		1	1	1	3	1
Hydracarina									1	1	
Collembola	1		3				1				
Isonychia		3	10	10			3	3			
Acentrella turbida		1	1								
Baetis intercalaris		10	10	10			10	10			
Callibaetis					1					3	
Centroptilum	1				3	1					
Plauditus		1	1	3			1	1			
Leucrocuta	1		1				1	3			
Heptagenia						1					
Maccaffertium exiguum									1		
Maccaffertium pulchellum		3	3	10			3	10	10		
Maccaffertium terminatum	3	1		1		10	1	1	1		
Stenacron	10	1	3	10	10	10		3	10	10	10
Stenonema femoratum											1
Tricorythodes	10	10	10	10	10	10	10	10	10	3	3
Caenis	1				3	3	3	3	10	3	10
Anthopotamus myops	1				3	1					3
Hetaerina		3						1			
Argia	10	1	1	3	3	3	3	3	10	10	1
Enallagma	3	3			1		3			3	3

Table 8 (cont.)

TAXA	GMRSD 30 A	GMRSD 29 A	GMRSD 28 A	GMRSD 27 A	GMRSD 26 A	GMRSD 25 A	GMRSD 24 A	GMRSD 22 A	GMRSD 21 A	GMRSD 20 A	GMRSD 23 A
Boyeria vinosa							1			1	
Aeshna						1				1	
Gomphus	1									1	
Epitheca princeps		1									
Belostoma flumineum	1					3	3	1			1
Palmacorixa					1						1
Trichocorixa	10	1	3	10	10	10	3		3		3
Ranatra										1	
Corydalus cornutus									1		
Sialis					3		1				
Chimarra obscura		1		1							
Cyrnellus fraternus	1				1				1		1
Ceratopsyche morosa		10	10	10			10	10			
Cheumatopsyche	1	10	10	10		3	10	10	10		
Hydropsyche aerata	1	3	3	3		1	10	10	3		
Hydropsyche bidens							3				
Hydropsyche orris		1		3			10	10			
Hydropsyche simulans							1				
Hydroptila	3	3	1	3	1	3	1	1	10		
Nectopsyche candida	1										
Oecetis					3						
Petrophila		1					1	1			
Laccophilus maculosus	3				3		1			3	
Dineutus	1										
Peltodytes					1	1			1	3	1
Helichus	1							1		1	
Ancyronyx variegata						1		3			
Macronychus glabratus				1				1			
Stenelmis	10	10	3	10	10	3	10	10	3	10	
Tropisternus	3	3				1	3	1		10	3
Berosus	1	1			1	3					
Enochrus		3								1	
Ceratopogonidae					1						

Table 8 (cont.)

TAXA	GMRSD 30 A	GMRSD 29 A	GMRSD 28 A	GMRSD 27 A	GMRSD 26 A	GMRSD 25 A	GMRSD 24 A	GMRSD 22 A	GMRSD 21 A	GMRSD 20 A	GMRSD 23 A
Atrichopogon											1
Procladius				1	10	1	1	1	1	3	10
Ablabesmyia mallochi	1				1	1	1	3	3	1	3
Labrundinia						1					
Thienemannimyia grp.	1	10	1	1		10	1	10	3		
Cricotopus bicinctus grp.	1	3	3	10	1	3	3	3	3		
Nanocladius crassicornus/rectinervis		1					1	3			
Nanocladius distinctus	1	1			1				3		
Chironomus	10	1	1	10	3					1	3
Cryptochironomus								1		1	
Dicrotendipes neomodestus	10	1		1	10	10	3	10	10	10	3
Dicrotendipes simpsoni						1					
Glyptotendipes	10	10	3	10	10	10	10	10	10	10	10
Parachironomus										1	
Parachironomus frequens		1							3		
Phaenopsectra obediens grp.	3	1					1	1			
Polypedilum flavum	3	10	10	10	1	10	10	10	1	3	3
Polypedilum halterale grp.											1
Polypedilum illinoense	1							1			1
Polypedilum scalaenum grp.	1	1		1	1		1	1			
Pseudochironomus											1
Rheotanytarsus		10	10	3	1		10	3	3		
Tanytarsus glabrescens grp.	1		1		3						
Tanytarsus guerlus grp.	3	1						3	1		1
Simulium		3					1				
Ephydridae	1										
Elimia	3	1		10	3	10	10	3	10	3	1
Fossaria	1										
Physa	3	1	3	1	10	1	3	1		3	1
Helisoma	1						3			1	
Menetus											3

Table 8 (cont.)

TAXA	GMRSD 30 A	GMRSD 29 A	GMRSD 28 A	GMRSD 27 A	GMRSD 26 A	GMRSD 25 A	GMRSD 24 A	GMRSD 22 A	GMRSD 21 A	GMRSD 20 A	GMRSD 23 A
Ferrissia				3	1						
Corbicula fluminea	3										
Musculium		3		10	3	1	3	10	10	10	1
Total Taxa Richness	50	46	26	35	44	38	49	46	36	40	36
EPT Taxa Richness	12	14	12	13	9	10	15	14	10	4	6
Grand Total						99					

[1]Abundance assigned as 1=1-2 individuals, 3=3-9 individuals, and 10=≥10 individuals.

Table 9. ICI Metric Results and Scores for Benthic Macroinvertebrate Sampling Locations on the Great Miami River near the AK Steel Hamilton Site, September 2007.

LOCATION	DRAINAGE AREA	ICI TOTAL SCORE	TOTAL NUMBER	# TOTAL TAXA	SCORE	# MAYFLY TAXA	SCORE	# CADDISFLY TAXA	SCORE	# DIPTERA TAXA	SCORE	% MAYFLIES	SCORE	% CADDISFLIES	SCORE	% TANYTARSINI	SCORE	% OTHER	SCORE	% TOLERANT	SCORE	# QUAL EPT TAXA	SCORE
GMRSD30	3297	44	14,673	25	4	8	6	5	4	8	4	53.1	6	29.6	4	2.3	2	15.0	4	1.1	6	12	4
GMRSD29	3298	50	11,982	24	4	7	6	4	4	8	4	36.2	6	48.5	6	4.8	2	10.4	6	1.0	6	14	6
GMRSD28	3298	42.7[1]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	4
GMRSD27	3298	39.8[1]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	4
GMRSD26	3298	26	2,645	21	2	4	2	2	2	9	6	19.5	6	22.2	4	1.5	2	56.8	0	5.9	0	9	2
GMRSD25	3298	42	5,880	25	4	7	6	5	4	7	4	41.1	6	31.3	4	9.8	4	17.7	4	2.7	2	10	4
GMRSD24	3298	48	12,686	26	4	7	6	6	4	8	4	23.3	6	53.3	6	6.8	2	15.5	4	0.9	6	15	6
GMRSD22	3298	46	19,436	27	4	8	6	7	4	7	4	11.6	4	69.5	6	1.2	2	17.7	4	0.8	6	14	6
GMRSD21	3298	24	8,645	24	4	4	2	2	2	7	4	5.2	2	0.5	0	0.0	0	94.2	0	0.8	6	10	4
GMRSD20	3298	42	12,809	27	4	8	6	6	4	7	4	47.5	6	39.1	4	3.1	2	10.3	6	0.4	6	4	0
GMRSD23	3298	34	4,137	24	4	7	6	3	2	9	6	33.8	6	28.3	4	5.6	2	32.2	0	2.8	2	6	2

[1]HD samplers missing or vandalized. ICI score could not be calculated. Value represents the median QCTV from the qualitative samples.

Table 10. Summary of QHEI Metric Scores in the Great Miami River near the AK Steel Hamilton Site, September 2007.

Location	Substrate	Cover	Channel	Riparian	Pool/Current	Riffle/Run	Gradient	QHEI Score
GMRF30	20	11	16.5	6.5	12	7	10	83
GMRF27	10	14	11.5	4.5	11	0	10	61
GMRF25	17.5	9	14	4.5	11	6.5	10	72.5
GMRF20R	17	10	13.5	5	9	0	8	62.5
GMRF20L	17	16	13	5	10	0	8	69

Table 11. Water Quality Measurements in the Great Miami River near the AK Steel Hamilton Site in September and October, 2007.

Location	Temperature (C)		Dissolved Oxygen (mg/l)		Specific Conductance (uS/cm)		Secchi (cm)	
	Sept	Oct	Sept	Oct	Sept	Oct	Sept	Oct
GMRF30	27.1	21.9	14.1	10.5	921	933	49.0	44.0
GMRF27	26.3	21.8	11.6	10.9	924	934	47.0	44.0
GMRF25	27.1	21.6	18.1	11.6	896	928	49.0	44.0
GMRF20R	25.1	21.7	6.6	6.9	925	940	43.0	44.0
GMRF20L	25.7	17.9	8.9	8.9	938	962	66.0	43.0
Mean	26.3	21.0	11.9	9.8	920.8	939.4	50.8	43.8

Table 12. Summary of QHEI, IBI, IWBmod, ICI, and QCTV scores in the Great Miami River near the AK Steel Hamilton Site, 2007.

Location	QHEI	Mean IBI	IBI WWH Biocriterion	Mean IWBmod	IWBmod WWH Biocriterion	ICI	ICI Biocriterion	Median QCTV	QCTV 25th Percentile	Attainment
30		41.0	42	9.7	8.5	44	36	–	–	
29	83.0	–	–	–	–	50	36	–	–	
28		–	–	–	–	–[a]	–	43.0[b]	38.7	
Upstream Mean	**83.0**	**41.0[c]**	**42**	**9.7**	**8.5**	**47**	**36**	**–**	**–**	**FULL**
27	**61.0**	**37.0**	**42**	**8.1[d]**	**8.5**	**–[a]**	**–**	**39.9[b]**	**38.7**	**PARTIAL**
26		–	–	–	–	26	36	–	–	
25	72.5	45.0	42	9.6	8.5	42	36	–	–	
24		–	–	–	–	48	36	–	–	
22		–	–	–	–	46	36	–	–	
Mean	**72.5**	**45.0**	**42**	**9.6**	**8.5**	**40.5**	**36**	**–**	**–**	**FULL**
21	–	–	–	–	–	–[e]	–	–	–	
20R	62.5	41.0	42	8.8	8.5	42	36	–	–	
20L	69.0	45.0	42	9.2	8.5					
23	–	–	–	–	–	34[c]	36	–	–	
Mean	**65.8**	**43.0**	**42.0**	**9.0**	**8.5**	**38.0**	**36.0**	**–**	**–**	**FULL**
Adjacent & Downstream Mean	**66.3**	**42.0**	**42.0**	**8.9**	**8.5**	**40.8**	**36.0**	**–**	**–**	**–**

[a]HD samplers missing or vandalized.
[b]Median QCTV >25th percentile QCTV score for Good and Excellent ICI sites suggests that the WWH biocriterion is being achieved.
[c]IBI/ICI within 4 units of the IBI criterion (i.e., within OEPA's Area of Insignificant Departure).
[d]Mean IWBmod within 0.5 units of the IWBmod criterion (i.e., within OEPA's Area of Insignificant Departure).
[e]Benthic data were not incorporated in the attainment assessment due to severe flow restrictions at the site.

APPENDIX C
SURFACE SOIL SAMPLING RESULTS, 2008

APPENDIX C
AOC 22 Surface Soil Data
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

Sample Location:			AOC22RA1	AOC22RA2	AOC22RA3	AOC22RA4	AOC22RA5	AOC22RA6	AOC22RA7	AOC22RA8	AOC22RA9	AOC22RA10	AOC22RA11	AOC22RA12	AOC22RA13	AOC22RA14	AOC22RA15	AOC22RA16	AOC22RA17	AOC22RA18
Sample Top (ft below ground surface):			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sample Bottom (ft below ground surface):			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sample Date:			05/27/2008	05/27/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/27/2008
Analyte	DAF 10 (ug/kg)	ESL (ug/kg)																		
Volatile Organic Compounds (ug/kg)																				
1,1,1-Trichloroethane	1.0E+03	3.0E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	ND, L	ND, L	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,1,2,2-Tetrachloroethane	2.0E+00	1.3E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,1,2-Trichloro-1,2,2-trifluoroe	NE	NE	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,1,2-Trichloroethane	9.0E+00	2.9E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,1-Dichloroethane	1.0E+04	2.0E+04	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	<105 U
1,1-Dichloroethene	3.0E+01	8.3E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,2,4-Trichlorobenzene	3.0E+03	1.1E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 UJ	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,2-Dibromo-3-chloropropane	NE	3.5E+01	<3.34 U	<2.3 U	<2.28 U	2.36 U	2.46 U	5.38 U	<2.06 U	2.46 U	<2.28 U	<257 U	<270 U	<1.78 U	<2.31 U	<2.33 U	<2.4 U	<2.42 U	<2.55 U	<209 U
1,2-Dibromoethane	NE	1.2E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,2-Dichlorobenzene	9.0E+03	3.0E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,2-Dichloroethane	1.0E+01	2.1E-04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,2-Dichloropropane	1.0E+01	3.3E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,3-Dichlorobenzene	NE	3.8E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 UJ	<0.6 U	<0.604 U	<0.639 U	<52.3 U
1,4-Dichlorobenzene	1.0E+03	5.5E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 UJ	<0.6 U	<0.604 U	<0.639 U	<52.3 U
2-Butanone	NE	9.0E+04	<4.17 U	<2.87 U	<2.85 U	<2.95 U	<3.08 U	6.73 U	<2.57 U	<3.08 U	<2.85 U	<321 U	<338 U	<2.22 U	<2.88 U	<2.92 U	<3 U	<3.02 U	<3.19 U	<261 U
2-Hexanone	NE	1.3E+04	<4.17 U	<2.67 U	<2.85 U	<2.95 U	<3.08 U	6.73 U	<2.57 U	<3.08 U	<2.85 U	<321 U	<338 U	<2.22 U	<2.88 U	<2.92 U	<3 U	<3.02 U	<3.19 U	<161 U
4-Methyl-2-pentanone	NE	4.4E+05	<4.17 U	<2.87 U	<2.85 U	<2.95 U	<3.08 U	6.73 U	<2.57 U	<3.08 U	<2.85 U	<321 U	<338 U	<2.22 U	<2.88 U	<2.92 U	<3 U	<3.02 U	<3.19 U	<261 U
Acetone	8.0E+03	2.5E+03	36.3	<5.74 U	<5.7 U	<5.9 U	<6.15 U	13.5 U	<5.15 U	<6.16 U	<5.7 U	<641 U	<676 U	<4.44 U	<5.77 U	<5.83 UJ	<6 U	<6.04 U	7.54 J	<523 U
Benzene	2.0E+01	2.6E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Bromodichloromethane	3.0E+02	5.4E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Bromoform	4.0E+02	1.6E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Bromomethane	1.0E+02	2.4E+02	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	<105 U
Carbon disulfide	2.0E+04	9.4E+01	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Carbon tetrachloride	3.0E+01	3.0E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Chlorobenzene	7.0E+02	1.3E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Chloroethane	NE	NE	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	<105 U
Chloroform	3.0E+02	1.2E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Chloromethane	NE	1.0E+04	3.34 U	<2.3 U	<2.28 U	<2.36 U	<2.46 U	5.38 U	<2.06 U	<2.46 U	<2.28 U	<257 U	<270 U	<1.78 U	<2.31 U	<2.33 U	<2.4 U	<2.42 U	<2.55 U	<209 U
cis-1,2-Dichloroethene	2.0E+02	7.8E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
cis-1,3-Dichloropropene	NE	4.0E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 UJ	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Cyclohexane	NE	1.0E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	73.4 J
Dibromochloromethane	2.0E+02	2.1E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Dichlorodifluoromethane	NE	4.0E+04	<0.417 U	<0.287 U	<0.285 U	<0.295 U	<0.308 U	0.673 U	0.257 U	<0.308 U	<0.285 U	<32.1 U	<33.8 U	<0.222 U	<0.288 U	<0.292 U	<0.3 U	<0.302 U	<0.319 U	<26.1 U
Ethylbenzene	7.0E+03	5.2E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Isopropylbenzene	NE	NE	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Methyl acetate	NE	NE	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<383 J	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	1190
Methylcyclohexane	NE	NE	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	266
Methylene chloride	1.0E+01	4.1E+03	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.28 U	<105 U
Methyl-tert-butyl-ether	NE	NE	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<1.26 U	<105 U
Styrene	2.0E+03	4.7E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Tetrachloroethene	3.0E+01	9.9E+03	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Toluene	6.0E+03	2.0E+05	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
trans-1,2-Dichloroethene	3.0E+02	7.8E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
trans-1,3-Dichloropropene	NE	4.0E+02	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Trichloroethene	3.0E+01	1.2E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	<52.3 U
Trichlorofluoromethane	NE	1.6E+04	<0.417 U	<0.287 U	<0.285 U	<0.295 U	<0.308 U	<0.673 U	<0.257 U	<0.308 U	0.285 U	<32.1 U	<33.8 U	<0.222 U	<0.288 U	0.292 U	<0.3 U	<0.302 U	<0.319 U	<26.1 U
Vinyl chloride	7.0E+00	6.5E+02	<1.67 U	<1.15 U	<1.14 U	<1.18 U	<1.23 U	<2.69 U	<1.03 U	<1.23 U	<1.14 U	<128 U	<135 U	<0.889 U	<1.15 U	<1.17 U	<1.2 U	<1.21 U	<0.128 U	<105 U
Xylene	1.0E+05	1.0E+04	<0.835 U	<0.574 U	<0.57 U	<0.59 U	<0.615 U	<1.35 U	<0.515 U	<0.616 U	<0.57 U	<64.1 U	<67.6 U	<0.444 U	<0.577 U	<0.583 U	<0.6 U	<0.604 U	<0.639 U	265 J
Semi-volatile Organic Compounds (ug/kg)																				
1,1-Biphenyl	NE	6.0E+04	<99.3 U	4560	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
1-Methylnaphthalene	NE	NE	16.8 J	<1090 U	<31.6 U	58.6 J	70.9	<101 U	16.8 J	<106 U	32.4	28.9	<1810 U	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	125
2,4,5-Trichlorophenol	1.4E+05	4.0E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2,4,6-Trichlorophenol	8.0E+01	9.9E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2,4-Dichlorophenol	5.0E+02	8.8E+04	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
2,4-Dimethylphenol	4.0E+03	1.0E+01	<397 U	<4370 U	<413 U	<822 U	<413 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 UJ	<819 U	<833 U	<717 U	<88.1 U
2,4-Dinitrophenol	1.0E+02	2.0E+04	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<352 U
2,4-Dinitrotoluene	4.0E-01	1.3E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2,6-Dinitrotoluene	3.0E-01	3.3E+01	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
2-Chloronaphthalene	NE	1.2E+01	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2-Chlorophenol	2.0E+03	2.4E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 U	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2-Methylnaphthalene	NE	3.2E+03	23.8 J	1520	<103 U	63.9	159	18.8 J	23.5	19.4 J	46.4	41.7	1820 J	2680	2680	<99.7 UJ	<205 U	<208 U	<179 U	174 J
2-Methylphenol	NE	NE	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 U	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
2-Nitroaniline	NE	7.4E+04	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<352 U
2-Nitrophenol	NE	5.1E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
3,3'-Dichlorobenzidine	3.0E+00	6.5E+02	<199 U	<2190 U	<207 U	<411 U	<213 U	<202 U	<196 U	<212 U	<368 U	<373 U	<3610 UJ	<1750 U	<906 U	<199 UJ	<410 U	<417 U	<358 U	<176 U
3-,4-Methylphenol	NE	NE	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<88.1
3-Nitroaniline	NE	3.2E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 U	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<352 U
4,6-Dinitro-2-methylphenol	NE	1.4E+02	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<352 U
4-Chloro-3-methylphenol	NE	8.0E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
4-Chloroaniline	3.0E+02	1.1E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
4-Chlorophenyl-phenyl-ether	NE	NE	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	
4-Nitroaniline	NE	2.2E+04	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<352 U
4-Nitrophenol	NE	5.1E+03	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<352 U
Acenaphthene	2.9E+05	2.0E+04	18.6 J	2260	<103 U	36.2 J	15.9 J	15.7 J	15 J	<106 U	21.8 J	33.8 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<13.5 U
Acenaphthylene	NE	6.8E+05	190 J	16600	160	516	<107 U	<101 U	<98.2 U	<106 U	<184 U	173	18000 J	15800	907	84.6	<205 U	<208 U	<179 U	163
Acetophenone	NE	3.0E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Anthracene	5.9E+06	1.5E+06	126 J	33200	156	469	<107 U	87.1	<98.2 U	<106 U	<184 U	193	19800 J	17600	792 J	96.9	<205 U	<208 U	<179 U	92.2
Atrazine	NE	NE	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U

AOC 22 Surface Soil Data
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

		Sample Location:	AOC22RA1	AOC22RA2	AOC22RA3	AOC22RA4	AOC22RA5	AOC22RA6	AOC22RA7	AOC22RA8	AOC22RA9	AOC22RA10	AOC22RA11	AOC22RA12	AOC22RA13	AOC22RA14	AOC22RA15	AOC22RA16	AOC22RA17	AOC22RA18
		Sample Top (ft below ground surface):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sample Bottom (ft below ground surface):	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
		Sample Date:	05/27/2008	05/27/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/28/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/29/2008	05/27/2008
Analyte	DAF 10 (ug/kg)	ESL (ug/kg)																		
Semi-volatile Organic Compounds (µg/kg)																				
Benzaldehyde	NE	NE	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Benzo(a)anthracene	8.0E+02	5.2E+03	1070	45500	1230	1700	383	562	431	236	648	2340	50100 J	32400	2890	446	342 J	842	278	338
Benzo(a)pyrene	4.0E+03	1.5E+03	823	30800	892	1260	297	464	373	236	757	1860	37600 J	24900	3190	343	<205 U	730	245	339
Benzo(b)fluoranthene	2.0E+03	6.0E+04	762	40800	550	1420	384	304	640	290	620	2300	24100 J	32200	3230	268	372	1100	212	469
Benzo(g,h,i)perylene	NE	1.2E+05	391	9650 J	398	507 J	257 J	217 J	459 J	210 J	533	788 J	18100 J	9080	2050	197 J	<205 U	399 J	<179 U	227 J
Benzo(k)fluoranthene	2.0E+04	1.5E+05	<99.3 U	19800	467	1430	315 J	337	670	235	633	1260	38100 J	<876 U	<453 U	423	<205 U	<208 U	<179 U	375
Bis(2-Chloroethoxy)methane	NE	3.0E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Bis(2-Chloroethyl)ether	2.0E-01	2.4E+04	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Bis(Chloroisopropyl)ether	NE	NE	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Bis(2-Ethylhexyl)phthalate	NE	9.3E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Butylbenzylphthalate	8.1E+06	2.4E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Caprolactam	NE	NE	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Carbazole	3.0E+02	NE	<99.3 U	1550	214	248 J	<107 U	106 J	<98.2 U	<106 U	<184 U	229 J	7010 J	9290	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Chrysene	8.0E+04	4.7E+03	833	41600	1080	1590	402	613	454	267	793	2190	44800 J	28500	3390	435	387 J	889	298	398
Dibenz(a,h)anthracene	8.0E+02	1.8E+04	182	5170 J	104	344	<107 U	78.1	165	66.6	167	<187 U	5630 J	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	107
Dibenzofuran	NE	NE	<99.3 U	21300	159 J	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	6040 J	11900	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Diethylphthalate	NE	1.0E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Dimethylphthalate	NE	7.3E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Di-n-butylphthalate	2.7E+06	2.0E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Di-n-octylphthalate	1.0E+08	7.1E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Fluoranthene	2.1E+06	1.2E+05	1680	144000	1400	4390	886	802	1020	573	933	5020	128000 J	57800	11000	933	937	2120	706	604
Fluorene	2.8E+05	1.2E+05	<99.3 U	33100	66.9	251 J	34.3	25.6	26.4	<106 U	42.4	61.2	12700 J	17800	503 J	<99.7 U	<205 U	<208 U	<179 U	18.6 J
Hexachlorobenzene	1.0E+03	2.0E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Hexachlorobutadiene	1.0E+03	4.0E+01	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Hexachlorocyclopentadiene	2.0E+05	7.6E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
Hexachloroethane	2.0E+02	6.0E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
Indeno(1,2,3-cd)pyrene	7.0E+03	1.1E+05	335	11100	402	539	263 J	216	443 J	217	437 J	809	17100 J	9410	1710	182 J	<205 U	381 J	<179 U	201
Isophorone	3.0E+02	1.4E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
Naphthalene	4.0E+04	9.9E+01	66.5	51000	112	135	1400	46.2	43	29.4	83.5	58.7	5020 J	8040	<453 U	<99.7 U	<205 U	<208 U	<179 U	130
Nitrobenzene	7.0E+01	1.3E+03	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
N-Nitroso-di-n-propylamine	2.0E-02	5.4E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<88.1 U
N-Nitrosodiphenylamine	6.0E+02	5.5E+02	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 UJ	<205 U	<208 U	<179 U	<88.1 U
o-Cresol (2-Methylphenol)	8.0E+03	4.0E+04	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	
p-Cresol (4-Methylphenol)	NE	1.6E+05	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	
Pentachlorophenol	1.0E+01	3.0E+03	<397 U	<4370 U	<413 U	<822 U	<426 U	<405 U	<98.2 U	<106 U	<184 U	<187 U	<1810 UJ	<876 U	<453 U	<99.7 U	<205 U	<208 U	<179 U	<352 U
Phenanthrene	NE	4.6E+04	580	137000	1850	2210	334	670	317	194	631	1480	90000 J	66600	4460	386	<205 U	568	231	199
Phenol	5.0E+04	7.0E+04	<99.3 U	<1090 U	<103 U	<205 U	<107 U	<101 U	<393 U	<425 U	<736 U	<747 U	<7230 UJ	<3500 U	<1810 U	<399 U	<819 U	<833 U	<717 U	<88.1 U
Pyrene	2.1E+06	7.9E+04	1230	80800	1970	2750	567	962	652	395	784	3440	97100 J	65400	9340	658	613	1370	456	586
Polychlorinated Biphenyls (µg/kg)																				
Aroclor 1016	NE	4.0E+04	<10.1 U	<10.9 U	<10.4 U	<51.5 U	<53.5 U	<10.2 U	<9.89 U	<53.9 U	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	<9.96 U	<10.3 U	<10.3 U	<9.28 U	<9.16 U
Aroclor 1221	NE	4.0E+04	<10.1 U	<10.9 U	<10.4 U	<51.5 U	<53.5 U	<10.2 U	<9.89 U	<53.9 U	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	<9.96 U	<10.3 U	<10.3 U	<9.28 U	<9.16 U
Aroclor 1232	NE	4.0E+04	<10.1 U	<10.9 U	<10.4 U	<51.5 U	<53.5 U	<10.2 U	<9.89 U	<53.9 U	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	<9.96 U	<10.3 U	<10.3 U	<9.28 U	<9.16 U
Aroclor 1242	NE	4.0E+04	<10.1 U	<10.9 U	<10.4 U	<51.5 U	<53.5 U	<10.2 U	<9.89 U	<53.9 U	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	<9.96 U	<10.3 U	<10.3 U	<9.28 U	<9.16 U
Aroclor 1248	NE	4.0E+04	96	<10.9 U	114	<51.5 U	<53.5 U	123	165	<53.9 U	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	198	81	<10.3 U	<9.28 U	<9.16 U
Aroclor 1254	NE	4.0E+04	149	202 J	705	1340 J	1580	271	559	2150 J	<9.45 U	<9.46 U	<9 U	<8.73 U	<9.25 U	<9.96 U	164	317	77.1	<9.16 U
Aroclor 1260	NE	4.0E+04	82.7	<10.9 U	<10.4 U	<51.5 U	<53.5 U	<10.2 U	366	<53.9 U	44.6	47.6	31.9 J	98.9 J	41.5 J	110	115	487	29.8	77.1
Total PCBs*	NE	4.0E+04	327.9	234.7	845	1494.5	1740.5	419.5	1131.8	2311.7	72.95	75.9	58.9	125.09	69.2	332.9	370.6	829.7	130.1	104.58
Inorganic Compounds (mg/kg)																				
Aluminum	NE	NE	6200	7490	8350	9120	9460	8080	7070	10200	16900	15100	6840 J	5830	11000	19200	6420	6250	3020	15200
Antimony	3.0E+00	2.7E-01	<0.0613 U	2.46 J	1.86 J-	2.46 J	2.42 J	0.685 J	1.46 J-	2.49 J-	0.324 J-	0.0636 J-	0.933 J	0.709 J	0.997 J	1.45 J	0.989 J	1.22 J	0.665 J	0.651 J
Arsenic	1.0E+01	1.8E+01	4.78	11.1	9.27	14.3	12.5	6.33	7.71	10.9	12.3	6.45	5.23	4.25	5.62	13.1	6.21	6.12	3.26	5.45
Barium	8.2E+02	3.3E+02	62.6	91.3	94.1	95.6	101	80.4	83.8	139	210	187	70 J	55.1	109	225	73.9	79.1	35.6	142
Beryllium	3.0E+01	2.1E+01	0.331	0.6	0.534	0.615	0.652	0.429	0.42	0.645	3.11	2.61	0.806 J	0.746	1.44	3.48	0.336	0.419	0.138	3.43
Cadmium	4.0E+00	3.6E-01	0.644	2.86	1.87	2.65	2.95	0.928	1.38	3.31	0.533	0.748	0.374 J	0.381 J	0.38 J	1.36	0.539 J	0.661	0.216 J	0.44
Calcium	NE	NE	76900	61800	64300	53800	57600	72800	63100	55000	140000	129000	94500 J	59000	96900	124000	84600	78000	85300	110000
Chromium (total)	2.0E+01	2.6E+01	14	29.2	33.8	50	59.8	23	37.9	74.4	28.1	28.2	10.8	9.59	17.6	33.7	15.4	92	7.42	28.2
Cobalt	NE	1.3E+01	4.89	7.25	7.05	7.96	6.26	6.38	6.76	10.3	3.64	3.92	3.38	2.99	3.69	6.42	6.28	7.63	3.51	2.44 J
Copper	NE	2.8E+01	16.9	33.6	37	45.8	62.1	24.1	30.9	65.5	23	32.8	15.7	14.9	17.1	10.6	21.2	23.2	11.6	26
Iron	NE	NE	16400	55000	47200	69200	65100	19900	28600	38200	18700	30800	14700	10400	15300	42200	12600	13900	8940	50000
Lead	NE	1.1E+01	44.2	294	171	323	341	49	75.6	129		66.3	25	26.1	21.8	87.1	26.6	49.2	10.2	82.3
Magnesium	NE	NE	23300	19800	22000	18900	18400	23200	21300	19100	19100	21700	20800	19000	23600	25700	26300	25400	24400	20100
Manganese	NE	5.0E+02	415	969	837	1220	1110	513	572	772	1770	3180	649 J	483	921	2480	402	452	236	3070
Mercury	NE	3.0E-01	0.0973 J	0.196	0.219	0.246	0.52	0.111 J	0.218	0.578	0.0679 J	0.0422 J	0.0631 J	<0.0291 UJ	0.0356 J	0.158 J	0.0807 J	0.394	0.0388 J	0.0237 J
Nickel	7.0E+01	2.8E+01	14.6	19	21.1	24.7	27	19.9	20.4	33.5	12.3	13	9.68	9.53	11.5	20.7	17.8	17.9	9.2	12.2
Potassium	NE	NE	1230	1250	1350	1600	1640	1450	1140	1400	1710	1510	723	665	1100	1300	1080	917	538	1730
Selenium	3.0E+00	1.0E+00	0.6	0.869	0.672	0.733	0.927	0.633	0.542	0.874	2.11	1.39	<0.539 U	0.699 J	0.702 J	1.38	<0.638 U	<0.628 U	<0.57 U	1.76
Silver	2.0E+01	4.2E+00	0.166 J	0.586	0.61	0.741	0.906	0.315	0.393	1.06	0.277	0.231	<0.269 U	<0.269 U	<0.286 U	0.571 J	<0.319 U	<0.314 U	<0.285 U	0.316
Sodium	NE	NE	135	126	113	112	118	118	109	112	550	502	194	179	313	603	119	131	119	975
Thallium	NE	1.0E+00	0.199	0.611	0.361	0.544	0.543	0.242	0.222	0.369	0.134	0.168	0.121	0.0908 J	0.0944 J	0.261	0.183	0.18	0.0597 J	0.0977
Vanadium	3.0E+03	7.8E+00	15.7	21	24.6	30.5	29.1	19.1	18.9	24.4	8.36	14	9.68	7.55	9.36	14.3	15.5	14.5	10.4	13.3
Zinc	6.2E+03	5.0E+01	134	747	495	989	1360	157	199	364	160	NA	73.5	81.1	76.8	265 J	90.5	199	35.5	228

APPENDIX C
On-Site Surface Soil Data*
AK Steel Former ARMCO Hamilton Plant
New Miami, Butler County, Ohio
Baseline Ecological Risk Assessment

			AOC1		AOC9		AOC13										AOC20										Block D						Block G	
Sample Location:			AOC1CA6SB5		MW-24S		MW25S		MW27M		MW28A		MW29A		MW31A		AOC20CA12SB3		AOC20CA12SB4		AOC20CA4SB3A		AOC20CA4SB3B		AOC20CA4SB4		BDSB9		BDSB10		MS26S		MW30S	
Sample Top (ft below ground surface):			0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0	
Sample Bottom (ft below ground surface):			2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2	
Sample Date:			6/12/2008		6/4/2008		6/2/2008		6/13/2008		5/28/2008		5/28/2008		5/28/2008		6/10/2008		6/10/2008		6/10/2008		6/9/2008		6/6/2008		6/11/2008		6/11/2008		6/2/2008		5/29/2008	
Analyte	DAF 10 (ug/kg)	ESL (ug/kg)																																
Volatile Organic Compounds																																		
1,1,1-Trichloroethane	1.0E+03	3.0E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,1,2,2-Tetrachloroethane	2.0E+00	1.3E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NE	NE	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,1,2-Trichloroethane	9.0E+00	2.9E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,1-Dichloroethane	1.0E+04	2.0E+04	<0.949	U	<1.25	UJ	<0.875	U	<0.976	U	<0.487	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.77	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<0.946	U
1,1-Dichloroethene	3.0E+01	8.3E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,2,4-Trichlorobenzene	3.0E+03	1.1E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
1,2-Dibromo-3-chloropropane	NE	3.5E+01	<0.475	U	<2.5	UJ	<1.75	U	<1.95	U	<1.95	U	<2.43	U	<1.84	U	<2.27	U	<2.03	U	<2.33	U	<2.33	U	<0.565	U	<1.96	U	<2.17	U	<2.59	U	<1.89	U
1,2-Dibromoethane	NE	1.2E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<2.26	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,2-Dichlorobenzene	9.0E+03	3.0E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
1,2-Dichloroethane	1.0E+01	2.1E-04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,2-Dichloropropane	1.0E+01	3.3E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
1,3-Dichlorobenzene	NE	3.8E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.608	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
1,4-Dichlorobenzene	1.0E+03	5.5E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
2-Butanone	NE	9.0E+04	<2.37	U	<3.12	UJ	<2.19	U	<2.44	U	<2.43	U	<3.04	U	<2.3	U	<2.84	U	7.84	J	<2.92	U	<2.91	U	<2.82	U	<2.45	U	<2.71	U	<3.24	U	<2.37	U
2-Hexanone	NE	1.3E+04	<2.37	U	<3.12	UJ	<2.19	U	<2.44	U	<2.43	U	<3.04	U	<2.3	U	<2.84	U	<2.54	U	<2.92	U	<2.91	U	<2.82	U	<2.45	U	<2.71	U	<3.24	U	<2.37	U
4-Methyl-2-pentanone	NE	4.4E+05	<2.37	U	<3.12	UJ	<2.19	U	<2.44	U	<2.43	U	<3.04	U	<2.3	U	<2.84	U	<2.54	U	<2.92	U	<2.91	U	<2.82	U	<2.45	U	<2.71	U	<3.24	U	<4.73	U
Acetone	8.0E+03	2.5E+03	<4.75	U	<6.24	UJ	<4.37	U	<4.88	U	<4.87	U	<6.08	U	<4.61	U	<5.67	U	16.1		<5.84	U	<5.82	U	<5.65	U	<4.9	U	<5.43	U	<6.47	U	<0.473	U
Benzene	2.0E+01	2.6E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	1.25	J	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Bromodichloromethane	3.0E+02	5.4E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Bromoform	4.0E+02	1.6E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.608	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Bromomethane	1.0E+02	2.4E+02	<0.949	U	<1.25	UJ	<0.875	U	<0.488	U	<0.487	U	<0.608	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<0.946	U
Carbon disulfide	2.0E+04	9.4E+01	<0.475	U	3.03	J	<0.437	U	<0.488	U	0.567	J	<0.608	U	<0.461	U	5.45	J	3.63	J	1.33	J	1.23	J	<0.565	U	<0.49	U	<0.543	U	2.5	J	<0.473	U
Carbon tetrachloride	3.0E+01	3.0E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Chlorobenzene	7.0E+02	1.3E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
Chloroethane	NE	NE	<0.949	U	<1.25	UJ	<0.875	U	<0.488	U	<0.487	U	<0.608	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<0.946	U
Chloroform	3.0E+02	1.2E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Chloromethane	NE	1.0E+04	<1.9	U	<2.5	UJ	<1.75	U	<1.95	U	<1.95	U	<2.43	U	<1.84	U	<2.27	U	<2.03	U	<2.33	U	<2.33	U	<2.26	U	<1.96	U	<2.17	U	<2.59	U	<189	U
cis-1,2-Dichloroethene	2.0E+02	7.8E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
cis-1,3-Dichloropropene	NE	4.0E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Cyclohexane	NE	1.0E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Dibromochloromethane	2.0E+02	2.1E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.608	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Dichlorodifluoromethane	NE	4.0E+04	<0.237	U	<0.312	UJ	<0.219	U	<0.244	U	<0.243	U	<0.304	U	<0.23	U	<0.567	U	<0.254	U	<0.292	U	<0.291	U	<0.282	U	<0.245	U	<0.271	U	<0.324	U	<0.237	U
Ethylbenzene	7.0E+03	5.2E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.538	U
Isopropylbenzene	NE	NE	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	1.31	J
Methyl acetate	NE	NE	<0.949	U	<1.25	UJ	<0.875	U	<0.976	U	<0.973	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<1.08	U
Methylcyclohexane	NE	NE	<0.949	U	<1.25	UJ	<0.875	U	<0.976	U	<0.973	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<1.08	U
Methylene chloride	1.0E+01	4.1E+03	5	U	<1.25	UJ	<0.875	U	<0.976	U	<0.973	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	4.9	U	3.8	J	<1.29	U	1.24	J
Methyl-tert-butyl-ether	NE	NE	<0.949	U	<1.25	UJ	<0.875	U	<0.976	U	<0.973	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<1.08	U
Styrene	2.0E+03	4.7E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
Tetrachloroethene	3.0E+01	9.9E+03	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	<0.647	U	<0.473	U
Toluene	6.0E+03	2.0E+05	<0.475	U	1.26	J	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.608	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	UJ	1.62	J	<0.473	U
trans-1,2-Dichloroethene	3.0E+02	7.8E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.608	U	<0.584	U	<0.682	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
trans-1,3-Dichloropropene	NE	4.0E+02	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	<0.461	U	<0.567	U	<0.508	U	<0.584	U	<0.682	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Trichloroethene	3.0E+01	1.2E+04	<0.475	U	<0.624	UJ	<0.437	U	<0.488	U	<0.487	U	<0.608	U	1.33	J	<0.567	U	<0.508	U	<0.584	U	<0.582	U	<0.565	U	<0.49	U	<0.543	U	<0.647	U	<0.473	U
Trichlorofluoromethane	NE	1.6E+04	<0.237	U	<0.312	UJ	<0.219	U	<0.244	U	<0.243	U	<0.304	U	<0.23	U	<0.284	U	<0.254	U	<0.292	U	<0.291	U	<0.282	U	<0.245	U	<0.271	U	<0.324	U	<0.237	U
Vinyl chloride	7.0E+00	6.5E+02	<0.949	U	<1.25	UJ	<0.875	U	<0.976	U	<0.973	U	<1.22	U	<0.922	U	<1.13	U	<1.02	U	<1.17	U	<1.16	U	<1.13	U	<0.98	U	<1.09	U	<1.29	U	<0.946	U
Xylene	1.0E+05	1.0E+04	<0.475	U	1.65	J	1.07	J	<0.488	U	<0.487	U	<0.608	U	<0.461	U	0.684	J	0.571	J	<0.584	U	<0.582	U	1.39	J	<0.49	U	<0.543	UJ	3.33	J	<0.473	U
Semi-volatile Organic Compounds																																		
1,1-Biphenyl	NE	6.0E+04	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
1-Methylnaphthalene	NE	NE	<5.48	U	116		<182	U	31.8		70.8		63.9	J	69.9		131		<25.6	UJ	<13.2	UJ	<13.5	U	37.5	J	106	J	<6.03	UJ	192		30.6	
2,4,5-Trichlorophenol	1.4E+05	4.0E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2,4,6-Trichlorophenol	8.0E+01	9.9E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2,4-Dichlorophenol	5.0E+02	8.8E+04	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2,4-Dimethylphenol	4.0E+03	1.0E+01	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2,4-Dinitrophenol	1.0E+02	2.0E+04	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1760	U	<3610	UJ	<399	UJ	<367	U	<379	U
2,4-Dinitrotoluene	4.0E-01	1.3E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2,6-Dinitrotoluene	3.0E-01	3.3E+01	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2-Chloronaphthalene	NE	1.2E+01	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2-Chlorophenol	2.0E+03	2.4E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2-Methylnaphthalene	NE	3.2E+03	<5.48	U	211		<182	U	64.6		80.7		66.6		<474	U	166		33.8	J	19	J	21.8	J	60.4	J	<902	UJ	<6.03	UJ	361		49.6	
2-Methylphenol	NE	NE	<88.5	U			<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
2-Nitroaniline	NE	7.4E+04	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<367	U	<379	U
2-Nitrophenol	NE	5.1E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
3,3'-Dichlorobenzidine	3.0E+00	6.5E+02	<177	U	<3690	U	<365	U	<184	U	<184	U	<1080	U	<947	U	<878	U	<87.7	UJ	<175	UJ	<174	U	<891	U	<1800	UJ	<200	UJ	<183	U	<190	U
3-,4-Methylphenol	NE	NE	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
3-Nitroaniline	NE	3.2E+03	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<367	U	<379	U
4,6-Dinitro-2-methylphenol	NE	1.4E+02	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<367	U	<379	U
4-Bromophenyl-phenylether			<88.5	U			<182	U	<92	U	<92.1	U	<542	U	<474	U	<1760	U	<351	UJ	<349	UJ	<13.5	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U		

4-Chloro-3-methylphenol	NE	8.0E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<349	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
4-Chloroaniline	3.0E+02	1.1E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
4-Chlorophenyl-phenyl-ether	NE	NE	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U		
4-Nitroaniline	NE	2.2E+04	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<367	U	<379	U
4-Nitrophenol	NE	5.1E+03	<354	U	<7380	U	<730	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<367	U	<379	U
Acenaphthene	2.9E+05	2.0E+04	<5.48	U	<1850	U	<182	U	<92	U	<92.1	U	151		<28.4	U	<439	U	207	J	26.3	U	<87.2	U	16.2	J	<902	UJ	<6.03	UJ	11.8		<94.8	U
Acenaphthylene	NE	6.8E+05	<5.48	U	192		382		11.7		211		373		163		219		89.5	J	19.1	J	18.5	J	215	J	<902	UJ	<6.03	UJ	30.1		<94.8	U
Acetophenone	NE	3.0E+05	<5.48	U	<1850	U	<182	U	46.6		<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Anthracene	5.9E+06	1.5E+06	<5.48	U	218		560		<92	U	98.3		690		115		206		8.16	J	82.8		214	U	320	J	<902	UJ	<6.03	UJ	44.4		<94.8	U
Atrazine	NE	NE	<5.48	U	<1850	U	<182	U	53.5		<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Semi-volatile Organic Compounds																																		
Benzaldehyde	NE	NE	<5.48	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Benzo(a)anthracene	8.0E+02	5.2E+03	<5.48	U	393		1100		274		209		2320		709		1090		456	J	413		1290		1380		2010		15.5	J	126		1142	
Benzo(a)pyrene	4.0E+03	1.5E+03	<5.48	U	378		842		285		211		1640		640		999		626	J	337		1020		1120		2370	J	13.6	J	121		119	
Benzo(b)fluoranthene	2.0E+03	6.0E+04	<5.48	U	430		1130		267		220	J	1260		590		797		499	J	281		982		2010		4500	J	11.3	J	209		127	
Benzo(g,h,i)perylene	NE	1.2E+05	<5.48	U	642		446		193		183	J	897		451		697		468	J	226		656		465	J	2990	J	7.87	J	108		86.2	
Benzo(k)fluoranthene	2.0E+04	1.5E+05	<5.48	U	289		437		237		204		1650		575		1170		622	J	398		928		1220		2380		11.3	J	125		117	
Bis(2-Chloroethoxy)methane	NE	3.0E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Bis(2-Chloroethyl)ether	2.0E-01	2.4E+04	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Bis(2-Chloroisopropyl)ether	NE	NE	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Bis(2-Ethylhexyl)phthalate	NE	9.3E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Butylbenzylphthalate	8.1E+06	2.4E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Caprolactam	NE	NE	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Carbazole	3.0E+02	NE	<88.5	U	<1850	U	376		<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Chrysene	8.0E+04	4.7E+03	<5.48	U	440		1190		267		212		2040		702		1120		465	J	469		1330		1320		2600		30.3	J	164		15.3	
Dibenz(a,h)anthracene	8.0E+02	1.8E+04	<5.48	U	112		<182	U	64.5		28.1		314		155		271		177	J	79.8		281		184	J	1240	J	<6.03	UJ	40.1		26.3	
Dibenzofuran	NE	NE	<88.5	U	<1850	U	290	J	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	126	J	<94.8	U
Diethylphthalate	NE	1.0E+06	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Dimethylphthalate	NE	7.3E+05	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Di-n-butylphthalate	2.7E+06	2.0E+05	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.6	UJ	<91.7	U	<94.8	U
Di-n-octylphthalate	1.0E+08	7.1E+05	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.6	U
Fluoranthene	2.1E+06	1.2E+05	<5.48	U	718		3240		483		242		1870		1180		2030		386	J	748		2320		2510		2610		18.8	J	203		280	
Fluorene	2.8E+05	1.2E+05	<5.48	U	<1850	U	343	J	24.9		36.4		291		33.8	J	33.6	J	51.2	J	51.8	U	<87.2	U	82.8	J	287	J	<6.03	UJ	13.5		14.3	
Hexachlorobenzene	1.0E+03	2.0E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Hexachlorobutadiene	1.0E+03	4.0E+01	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Hexachlorocyclopentadiene	2.0E+05	7.6E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Hexachloroethane	2.0E+02	6.0E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Indeno(1,2,3-cd)pyrene	7.0E+03	1.1E+05	<5.48	U	292		440		190		163		880		423		646		481	J	230		571		481	J	3080	J	<6.03	UJ	99.5		<94.8	U
Isophorone	3.0E+02	1.4E+05	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Naphthalene	4.0E+04	9.9E+01	<5.48	U	290		<182	U	1590	J	190		140		114		182	U	49.6	J	17	J	22.5	J	127	J	313	J	<6.03	UJ	194		1490	
Nitrobenzene	7.0E+01	1.3E+03	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.6	U
N-Nitroso-di-n-propylamine	2.0E-02	5.4E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
N-Nitrosodiphenylamine	6.0E+02	5.5E+02	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	UJ	<87.7	UJ	<87.3	UJ	<87.2	UJ	<445	UJ	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
o-Cresol (2-Methylphenol)	8.0E+03	4.0E+04															<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U							<94.8	U
p-Cresol (4-Methylphenol)	NE	1.6E+05															<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U							<94.8	U
Pentachlorophenol	1.0E+01	3.0E+03	<354	U	<7380	U	<399	U	<368	U	<368	U	<2170	U	<1890	U	<1760	U	<351	UJ	<349	UJ	<349	U	<1780	U	<3610	UJ	<399	UJ	<91.7	U	<379	U
Phenanthrene	NE	4.6E+04	<5.48	U	605		3320		292		334		1090		482		820		307	U	267	U	544		894	J	1700	J	11.3	J	287	J	13.5	
Phenol	5.0E+04	7.0E+04	<88.5	U	<1850	U	<182	U	<92	U	<92.1	U	<542	U	<474	U	<439	U	<87.7	UJ	<87.3	UJ	<87.2	U	<445	U	<902	UJ	<99.8	UJ	<91.7	U	<94.8	U
Pyrene	2.1E+06	7.9E+04	<5.48	U	643		2320		358		244		1450		997		1420	J	553	J	703		1990		2160		2560		15.7	J	166		20.5	
Polychlorinated Biphenyls																																		
Aroclor 1016	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	<8.85	U	<8.58	U	<8.86	U	<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	62.6	
Aroclor 1221	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	<8.85	U	<8.58	U	<8.86	U	<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	<11.1	U
Aroclor 1232	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	<8.85	U	<8.58	U	<8.86	U	<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	<11.1	U
Aroclor 1242	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	<8.85	U	<8.58	U	<8.86	U	<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	<11.1	U
Aroclor 1248	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	<8.85	U	<8.58	U	<8.86	U	<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	<11.1	U
Aroclor 1254	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	45.4		93.7		80.1		<8.85	U	<8.75	U	<9.14	U	<10.1	U	<9.19	U	<11.1	U
Aroclor 1260	NE	4.0E+04	<9	U	<9.21	U	<45.5	U	<9.23	U	<9.12	U	<10.9	U	<9.6	U	45.4		<8.58	U	<8.86	U	<8.85	U	115		22.8		<10.1	U	12	J	61.8	
Total PCBs*	NE	4.0E+04	31.5		32.2		169.2		32.3		31.9		38.1		33.6		112.9		119.4		26.58		30.9		141.2		50.2		35.35		32.16		182.15	
Inorganic Compounds																																		
Aluminum	NE	NE	7620		15700		13800		8400		12600		6740	J	36100	J	26500		26400		23600		26800		15000		13800	J	25400	J	7580		10300	
Antimony	3.0E+00	2.7E-01	<0.272	U	0.426	J	0.495	J	0.579	J	0.554	J	0.974	J	0.846	J	3.56	J-	<0.266	U	<0.27	U	<0.271	U	<0.26	U	<0.281	U	<0.315	UJ	0.853	J	0.646	J
Arsenic	1.0E+01	1.6E+01	5.55		17.9		10.2		5.07		7.9		4.68		0.178	J	18.9		5.12		0.474		<0.407	U	7.33	J-	7.89		11.6		12		6.38	
Barium	8.2E+02	3.3E+02	60.2		172		146		104		77.3		74.1	J	310	J	313		270		221		228		166		120	J	177	J	112		80	
Beryllium	3.0E+01	2.1E+01	0.55		3.39		2.07		1.37		0.58		0.512	J-	4.5	J-	4.46		4.93		7.35		7.09		2.76		1	J-	1.21	J-	1.41		0.81	
Cadmium	4.0E+00	3.6E-01	<0.136	U	2.18		1.06		0.144	J	0.257	J	1.14		<0.0292	U	0.963		0.546		<0.135	U	<0.136	U	0.271	J	0.578		0.513	J	0.228	J	0.336	J
Calcium	NE	NE	1580		99400		69600		71100		48600		98600	J	220000	J	136000		177000		174000		171000		57400		24800	J	4850	J	40800		38100	
Chromium (total)	2.0E+01	2.6E+01	12		27.6		16.1		10.5		15.7		16.2		5.65		57.1		20.5		17.6		14.8		16.6		15.9		24.4		35.7		13.1	
Cobalt	NE	1.3E+01	6.99		4.72		5.04		5.26		8.43		4.65		<0.729	U	9.61		3.64		<0.676	U	<0.678	U	8.27		14.4		11.7		4.07		7.59	
Copper	NE	2.8E+01	9.8	J+	46.1		21.9		19.1		17.2		17		2.97		231		17.1		2.9	J	2.9	J	16.3	J	19.7	J+	28.4	J+	69.9		15.6	
Iron	NE	NE	17000		73000		20100		13100		16100	J	13100		2200		101000		20800		4200		7340		21300		41700		4500		35700		15900	
Lead	NE	1.1E+01	10.2	J	166		497		31.7		25.7		26.7		1.53		283		54.5		3.02		1.86		21.8		20.8	J	19.7	J	69.3		20.4	
Magnesium	NE	NE	1500		16500		15900		15800		20200		27800		21800		21600		31700		41600		41300		16600		12900	J	4920	J	7050		12300	
Manganese	NE	5.0E+02	582		3420		1430		800		792		537	J	4200	J	5880		3720		3280		3100		2140		1120		1090		1640		640	
Mercury	NE	3.0E-01	<0.0106	U	0.0559	J	1.03		0.322	J	0.0201	J	0.0157	J	<0.0144	U	0.503		0.158	J-	<0.0108	UJ	<0.0108	UJ	0.0476	J	0.0106	J+	0.0328	J+	0.0271			
Nickel	7.0E+01	2.8E+01	11.7		16.7		10.8		12.3		16.4		13.4		4.71		65.1		12.1		5.41		5.2		16.9		32.2	J-	50.6	J-	20.9		15.1	
Potassium	NE	NE	547		1370		1240		758		1110		908		3460		2270		1510		1960		1950		1310		1720	J	3350	J	860		1030	
Selenium	3.0E+00	1.0E+00	<0.544	U	1.29		1.14		<0.571	U	<0.561	U	0.415		3.5		2.35		2.53		3.71		3.94		0.943	J-	<0.562	U	<0.631	U	1.11	J	<0.574	U
Silver	2.0E+01	4.2E+00	<0.272	UJ	0.692	J	<0.261	U	<0.286	U	<0.28	U	0.0898	J	0.187	J	0.289	J-	<0.266	UJ	0.418	J-	0.409	J-	<0.26	UJ	<0.281	UJ	<0.315	UJ	<0.287	U	<0.287	U
Sodium	NE	NE	29		515		4430		233		78.8		154		1340		942		846		1400		1510		342		79.9		53.9		6060		155	
Thallium	NE	1.0E+00	0.141		0.396		0.194		0.165		0.172		0.114		0.0141	J	0.0745	J	0.178		<0.0541	U	<0.0543	U	0.21		0.273		0.333		0.14		0.133	
Vanadium	3.0E+03	7.8E+00	19.8		16		9.82		9.38		25.5		15.6		5.24		22.2		9.25		12.3		11		18.8		24.8	J	37.5	J	12.1		19.4	
Zinc	6.2E+03	5.0E+01	39.7		533	J+	546		36.7		71.5		185		4.8		171	J+	200	J+	13.5	U	13.6	U	70	J	78.3	J	180		108	J+	63	

* - Data collected as result of 2008 sampling only.

APPENDIX D
SOIL pH ANALYSIS RESULTS, 2008

Former ARMCO Hamilton Plant Soil pH Measurement Results

Soil Sample Number	**Sample Location**	**Sample Description**	**pH Measurement**
1	Southern Parcel	brown loamy soil	8.02
2	Southern Parcel	brown sandy loam soil	8.42
3	Southern Parcel	brown sandy loam soil	8.39
4	Northern Parcel	gray-brown soil,	8.55
5	Northern Parcel	light gray sandy clay soil	8.75

Sampler: Paul Miller, KEMRON Environmental Services, Inc.

Signature: Paul J. Miller

Date: October 01, 2008

APPENDIX E
ProUCL VERSION 4.0 95%UCL STATISTICAL OUTPUT, 2008

General UCL Statistics for Full Data Sets

User Selected Options	
From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1-Methylnaphthalene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17
Raw Statistics		**Log-transformed Statistics**	
Minimum	15.8	Minimum of Log Data	2.76
Maximum	545	Maximum of Log Data	6.301
Mean	137.6	Mean of log Data	4.328
Median	64.75	SD of log Data	1.112
SD	165.9		
Coefficient of Variation	1.206		
Skewness	1.679		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.707	Shapiro Wilk Test Statistic	0.939
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	205.6	95% H-UCL	299.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	305.5
95% Adjusted-CLT UCL	218.5	97.5% Chebyshev (MVUE) UCL	379.9
95% Modified-t UCL	208.2	99% Chebyshev (MVUE) UCL	526.1
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.846	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	162.6		
nu star	30.45		
Approximate Chi Square Value (.05)	18.85	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	201.9
Adjusted Chi Square Value	17.98	95% Jackknife UCL	205.6
		95% Standard Bootstrap UCL	200.9
Anderson-Darling Test Statistic	0.823	95% Bootstrap-t UCL	239
Anderson-Darling 5% Critical Value	0.768	95% Hall's Bootstrap UCL	198.7
Kolmogorov-Smirnov Test Statistic	0.188	95% Percentile Bootstrap UCL	202.7
Kolmogorov-Smirnov 5% Critical Value	0.21	95% BCA Bootstrap UCL	213
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	308.1
		97.5% Chebyshev(Mean, Sd) UCL	381.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	526.8
95% Approximate Gamma UCL	222.3		
95% Adjusted Gamma UCL	233.1		

Potential UCL to Use	Use 95% Approximate Gamma UCL	222.3

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	0.0307	Minimum of Log Data	-3.485
Maximum	2.49	Maximum of Log Data	0.912
Mean	1.214	Mean of log Data	-0.214
Median	0.983	SD of log Data	1.207
SD	0.825		
Coefficient of Variation	0.68		
Skewness	0.404		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Test Statistic	0.8
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.553	95% H-UCL	3.964
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.787
95% Adjusted-CLT UCL	1.554	97.5% Chebyshev (MVUE) UCL	4.746
95% Modified-t UCL	1.556	99% Chebyshev (MVUE) UCL	6.631
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.176	Data appear Normal at 5% Significance Level	
Theta Star	1.033		
nu star	42.33		
Approximate Chi Square Value (.05)	28.41	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	1.534
Adjusted Chi Square Value	27.32	95% Jackknife UCL	1.553
		95% Standard Bootstrap UCL	1.53
Anderson-Darling Test Statistic	0.628	95% Bootstrap-t UCL	1.592
Anderson-Darling 5% Critical Value	0.759	95% Hall's Bootstrap UCL	1.535
Kolmogorov-Smirnov Test Statistic	0.193	95% Percentile Bootstrap UCL	1.533
Kolmogorov-Smirnov 5% Critical Value	0.208	95% BCA Bootstrap UCL	1.532
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2.062
		97.5% Chebyshev(Mean, Sd) UCL	2.429
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.15
95% Approximate Gamma UCL	1.809		
95% Adjusted Gamma UCL	1.881		

Potential UCL to Use	Use 95% Student's-t UCL	1.553

General UCL Statistics for Full Data Sets

User Selected Options

From File C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst

Full Precision OFF

Confidence Coefficient 95%

Number of Bootstrap Operations 2000

Benzo(a)anthracene

General Statistics

Number of Valid Observations 18

Number of Distinct Observations 18

Raw Statistics

Minimum	236
Maximum	50100
Mean	7874
Median	745
SD	16334
Coefficient of Variation	2.074
Skewness	2.097

Log-transformed Statistics

Minimum of Log Data	5.464
Maximum of Log Data	10.82
Mean of log Data	7.2
SD of log Data	1.741

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.515
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	14572
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	16240
95% Modified-t UCL	14889

Gamma Distribution Test

k star (bias corrected)	0.35
Theta Star	22513
nu star	12.59
Approximate Chi Square Value (.05)	5.619
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	5.177
Anderson-Darling Test Statistic	2.585
Anderson-Darling 5% Critical Value	0.826
Kolmogorov-Smirnov Test Statistic	0.318
Kolmogorov-Smirnov 5% Critical Value	0.219

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	17645
95% Adjusted Gamma UCL	19150

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.807
Shapiro Wilk Critical Value	0.897

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL	30970
95% Chebyshev (MVUE) UCL	16031
97.5% Chebyshev (MVUE) UCL	20757
99% Chebyshev (MVUE) UCL	30040

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	14207
95% Jackknife UCL	14572
95% Standard Bootstrap UCL	14048
95% Bootstrap-t UCL	19214
95% Hall's Bootstrap UCL	12697
95% Percentile Bootstrap UCL	14278
95% BCA Bootstrap UCL	16039
95% Chebyshev(Mean, Sd) UCL	24856
97.5% Chebyshev(Mean, Sd) UCL	31917
99% Chebyshev(Mean, Sd) UCL	46181

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 46181

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)pyrene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	102.5	Minimum of Log Data	4.63
Maximum	37600	Maximum of Log Data	10.53
Mean	5845	Mean of log Data	6.97
Median	743.5	SD of log Data	1.745
SD	11847		
Coefficient of Variation	2.027		
Skewness	2.086		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.53	Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	10703	95% H-UCL	25020
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	12858
95% Adjusted-CLT UCL	11905	97.5% Chebyshev (MVUE) UCL	16651
95% Modified-t UCL	10932	99% Chebyshev (MVUE) UCL	24103
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.381	Data do not follow a Discernable Distribution (0.05)	

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium (total)

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	7.42	Minimum of Log Data	2.004
Maximum	92	Maximum of Log Data	4.522
Mean	32.95	Mean of log Data	3.273
Median	28.2	SD of log Data	0.698
SD	23.03		
Coefficient of Variation	0.699		
Skewness	1.323		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk Test Statistic	0.977
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	42.39	95% H-UCL	49.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	58.41
95% Adjusted-CLT UCL	43.69	97.5% Chebyshev (MVUE) UCL	69.34
95% Modified-t UCL	42.67	99% Chebyshev (MVUE) UCL	90.82
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.043	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	16.13		
nu star	73.56		
Approximate Chi Square Value (.05)	54.81	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	41.88
Adjusted Chi Square Value	53.25	95% Jackknife UCL	42.39
		95% Standard Bootstrap UCL	41.38
Anderson-Darling Test Statistic	0.26	95% Bootstrap-t UCL	45.49
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL	47.98
Kolmogorov-Smirnov Test Statistic	0.121	95% Percentile Bootstrap UCL	42.03
Kolmogorov-Smirnov 5% Critical Value	0.206	95% BCA Bootstrap UCL	43.28
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	56.61
		97.5% Chebyshev(Mean, Sd) UCL	66.85
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	86.96
95% Approximate Gamma UCL	44.22		
95% Adjusted Gamma UCL	45.51		

Potential UCL to Use	Use 95% Approximate Gamma UCL	44.22

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chrysene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	267	Minimum of Log Data	5.587
Maximum	44800	Maximum of Log Data	10.71
Mean	7162	Mean of log Data	7.212
Median	813	SD of log Data	1.675
SD	14653		
Coefficient of Variation	2.046		
Skewness	2.105		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.518	Shapiro Wilk Test Statistic	0.795
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	13170	95% H-UCL	25118
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	14352
95% Adjusted-CLT UCL	14674	97.5% Chebyshev (MVUE) UCL	18525
95% Modified-t UCL	13456	99% Chebyshev (MVUE) UCL	26724
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.367	Data do not follow a Discernable Distribution (0.05)	
Theta Star	19519		
nu star	13.21		
Approximate Chi Square Value (.05)	6.034	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	12843
Adjusted Chi Square Value	5.574	95% Jackknife UCL	13170
		95% Standard Bootstrap UCL	12650
Anderson-Darling Test Statistic	2.637	95% Bootstrap-t UCL	17851
Anderson-Darling 5% Critical Value	0.822	95% Hall's Bootstrap UCL	11873
Kolmogorov-Smirnov Test Statistic	0.306	95% Percentile Bootstrap UCL	12677
Kolmogorov-Smirnov 5% Critical Value	0.218	95% BCA Bootstrap UCL	15048
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	22217
		97.5% Chebyshev(Mean, Sd) UCL	28731
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	41526
95% Approximate Gamma UCL	15680		
95% Adjusted Gamma UCL	16975		

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 41526

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Copper

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	10.6	Minimum of Log Data	2.361
Maximum	65.5	Maximum of Log Data	4.182
Mean	28.43	Mean of log Data	3.216
Median	23.65	SD of log Data	0.522
SD	15.86		
Coefficient of Variation	0.558		
Skewness	1.268		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.869	Shapiro Wilk Test Statistic	0.972
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	34.94	95% H-UCL	36.98
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	44.06
95% Adjusted-CLT UCL	35.78	97.5% Chebyshev (MVUE) UCL	50.87
95% Modified-t UCL	35.12	99% Chebyshev (MVUE) UCL	64.26

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.33	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8.539		
nu star	119.9		
Approximate Chi Square Value (.05)	95.59	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	34.58
Adjusted Chi Square Value	93.51	95% Jackknife UCL	34.94
		95% Standard Bootstrap UCL	34.25
Anderson-Darling Test Statistic	0.318	95% Bootstrap-t UCL	37.23
Anderson-Darling 5% Critical Value	0.743	95% Hall's Bootstrap UCL	38.72
Kolmogorov-Smirnov Test Statistic	0.115	95% Percentile Bootstrap UCL	34.48
Kolmogorov-Smirnov 5% Critical Value	0.205	95% BCA Bootstrap UCL	35.93
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	44.72
		97.5% Chebyshev(Mean, Sd) UCL	51.77
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	65.62
95% Approximate Gamma UCL	35.66		
95% Adjusted Gamma UCL	36.45		

Potential UCL to Use		Use 95% Approximate Gamma UCL	35.66

General UCL Statistics for Full Data Sets

User Selected Options	
From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Dibenzofuran

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17
Raw Statistics		**Log-transformed Statistics**	
Minimum	44.05	Minimum of Log Data	3.785
Maximum	21300	Maximum of Log Data	9.966
Mean	2253	Mean of log Data	5.187
Median	92.75	SD of log Data	1.98
SD	5639		
Coefficient of Variation	2.502		
Skewness	2.845		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.484	Shapiro Wilk Test Statistic	0.686
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4565	95% H-UCL	9902
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3388
95% Adjusted-CLT UCL	5392	97.5% Chebyshev (MVUE) UCL	4429
95% Modified-t UCL	4714	99% Chebyshev (MVUE) UCL	6474
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.267	Data do not follow a Discernable Distribution (0.05)	
Theta Star	8439		
nu star	9.613		
Approximate Chi Square Value (.05)	3.701	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	4439
Adjusted Chi Square Value	3.356	95% Jackknife UCL	4565
		95% Standard Bootstrap UCL	4287
Anderson-Darling Test Statistic	3.701	95% Bootstrap-t UCL	9658
Anderson-Darling 5% Critical Value	0.852	95% Hall's Bootstrap UCL	10470
Kolmogorov-Smirnov Test Statistic	0.423	95% Percentile Bootstrap UCL	4613
Kolmogorov-Smirnov 5% Critical Value	0.222	95% BCA Bootstrap UCL	5408
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8047
		97.5% Chebyshev(Mean, Sd) UCL	10553
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	15478
95% Approximate Gamma UCL	5852		
95% Adjusted Gamma UCL	6454		

Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	15478

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Fluoranthene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics

Minimum	573
Maximum	144000
Mean	20156
Median	1210
SD	44278
Coefficient of Variation	2.197
Skewness	2.375

Log-transformed Statistics

Minimum of Log Data	6.351
Maximum of Log Data	11.88
Mean of log Data	7.866
SD of log Data	1.828

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.502
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.781
Shapiro Wilk Critical Value	0.897

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	38311
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	43554
95% Modified-t UCL	39285

Assuming Lognormal Distribution

95% H-UCL	90413
95% Chebyshev (MVUE) UCL	40657
97.5% Chebyshev (MVUE) UCL	52841
99% Chebyshev (MVUE) UCL	76773

Gamma Distribution Test

k star (bias corrected)	0.326
Theta Star	61912
nu star	11.72
Approximate Chi Square Value (.05)	5.043
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	4.629
Anderson-Darling Test Statistic	2.66
Anderson-Darling 5% Critical Value	0.832
Kolmogorov-Smirnov Test Statistic	0.314
Kolmogorov-Smirnov 5% Critical Value	0.219

Data not Gamma Distributed at 5% Significance Level

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	37322
95% Jackknife UCL	38311
95% Standard Bootstrap UCL	37382
95% Bootstrap-t UCL	71731
95% Hall's Bootstrap UCL	45028
95% Percentile Bootstrap UCL	38314
95% BCA Bootstrap UCL	44963
95% Chebyshev(Mean, Sd) UCL	65647
97.5% Chebyshev(Mean, Sd) UCL	85331
99% Chebyshev(Mean, Sd) UCL	123997

Assuming Gamma Distribution

95% Approximate Gamma UCL	46841
95% Adjusted Gamma UCL	51037

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 123997

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Number of Valid Observations	17	Number of Distinct Observations	17
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	10.2	Minimum of Log Data	2.322
Maximum	341	Maximum of Log Data	5.832
Mean	107.1	Mean of log Data	4.202
Median	66.3	SD of log Data	1.019
SD	109.4		
Coefficient of Variation	1.021		
Skewness	1.391		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.769	Shapiro Wilk Test Statistic	0.96
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	153.5	95% H-UCL	223.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	236
95% Adjusted-CLT UCL	160.4	97.5% Chebyshev (MVUE) UCL	291.6
95% Modified-t UCL	155	99% Chebyshev (MVUE) UCL	400.8
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.026	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	104.4		
nu star	34.88		
Approximate Chi Square Value (.05)	22.37	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0346	95% CLT UCL	150.8
Adjusted Chi Square Value	21.32	95% Jackknife UCL	153.5
		95% Standard Bootstrap UCL	149.4
Anderson-Darling Test Statistic	0.569	95% Bootstrap-t UCL	171.2
Anderson-Darling 5% Critical Value	0.762	95% Hall's Bootstrap UCL	149.1
Kolmogorov-Smirnov Test Statistic	0.169	95% Percentile Bootstrap UCL	150.5
Kolmogorov-Smirnov 5% Critical Value	0.214	95% BCA Bootstrap UCL	159.6
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	222.8
		97.5% Chebyshev(Mean, Sd) UCL	272.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	371.2
95% Approximate Gamma UCL	167.1		
95% Adjusted Gamma UCL	175.3		

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Manganese

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics

Minimum	236
Maximum	3180
Mean	1112
Median	804.5
SD	909
Coefficient of Variation	0.817
Skewness	1.46

Log-transformed Statistics

Minimum of Log Data	5.464
Maximum of Log Data	8.065
Mean of log Data	6.746
SD of log Data	0.736

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.789
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.955
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	1485
95% UCLs (Adjusted for Skewness)	
95% Adjusted-CLT UCL	1543
95% Modified-t UCL	1497

Assuming Lognormal Distribution

95% H-UCL	1675
95% Chebyshev (MVUE) UCL	1978
97.5% Chebyshev (MVUE) UCL	2380
99% Chebyshev (MVUE) UCL	3112

Gamma Distribution Test

k star (bias corrected)	1.715
Theta Star	648.6
nu star	61.73
Approximate Chi Square Value (.05)	44.66
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	43.27
Anderson-Darling Test Statistic	0.842
Anderson-Darling 5% Critical Value	0.753
Kolmogorov-Smirnov Test Statistic	0.147
Kolmogorov-Smirnov 5% Critical Value	0.206

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	1537
95% Adjusted Gamma UCL	1587

Nonparametric Statistics

95% CLT UCL	1465
95% Jackknife UCL	1485
95% Standard Bootstrap UCL	1458
95% Bootstrap-t UCL	1605
95% Hall's Bootstrap UCL	1536
95% Percentile Bootstrap UCL	1470
95% BCA Bootstrap UCL	1517
95% Chebyshev(Mean, Sd) UCL	2046
97.5% Chebyshev(Mean, Sd) UCL	2450
99% Chebyshev(Mean, Sd) UCL	3244

Potential UCL to Use	Use 95% Approximate Gamma UCL	1537

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kamron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	0.0237	Minimum of Log Data	-3.742
Maximum	0.578	Maximum of Log Data	-0.548
Mean	0.173	Mean of log Data	-2.189
Median	0.104	SD of log Data	0.897
SD	0.168		
Coefficient of Variation	0.972		
Skewness	1.411		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.812	Shapiro Wilk Test Statistic	0.956
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.242	95% H-UCL	0.345
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.375
95% Adjusted-CLT UCL	0.253	97.5% Chebyshev (MVUE) UCL	0.461
95% Modified-t UCL	0.244	99% Chebyshev (MVUE) UCL	0.631

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.089	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.159		
nu star	39.2		
Approximate Chi Square Value (.05)	25.86	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	0.239
Adjusted Chi Square Value	24.82	95% Jackknife UCL	0.242
		95% Standard Bootstrap UCL	0.238
Anderson-Darling Test Statistic	0.407	95% Bootstrap-t UCL	0.267
Anderson-Darling 5% Critical Value	0.761	95% Hall's Bootstrap UCL	0.265
Kolmogorov-Smirnov Test Statistic	0.118	95% Percentile Bootstrap UCL	0.239
Kolmogorov-Smirnov 5% Critical Value	0.208	95% BCA Bootstrap UCL	0.252
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.346
		97.5% Chebyshev(Mean, Sd) UCL	0.421
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.568
95% Approximate Gamma UCL	0.263		
95% Adjusted Gamma UCL	0.274		

Potential UCL to Use		Use 95% Approximate Gamma UCL	0.263

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Naphthalene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	29.4	Minimum of Log Data	3.381
Maximum	51000	Maximum of Log Data	10.84
Mean	3708	Mean of log Data	5.381
Median	103.3	SD of log Data	2.089
SD	11994		
Coefficient of Variation	3.235		
Skewness	4.034		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.346	Shapiro Wilk Test Statistic	0.771
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	8625	95% H-UCL	18614
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5111
95% Adjusted-CLT UCL	11230	97.5% Chebyshev (MVUE) UCL	6705
95% Modified-t UCL	9073	99% Chebyshev (MVUE) UCL	9837

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.246	Data do not follow a Discernable Distribution (0.05)	
Theta Star	15094		
nu star	8.843		
Approximate Chi Square Value (.05)	3.232	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	8358
Adjusted Chi Square Value	2.914	95% Jackknife UCL	8625
		95% Standard Bootstrap UCL	8147
Anderson-Darling Test Statistic	3.13	95% Bootstrap-t UCL	38237
Anderson-Darling 5% Critical Value	0.863	95% Hall's Bootstrap UCL	36386
Kolmogorov-Smirnov Test Statistic	0.391	95% Percentile Bootstrap UCL	9205
Kolmogorov-Smirnov 5% Critical Value	0.223	95% BCA Bootstrap UCL	12882
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	16030
		97.5% Chebyshev(Mean, Sd) UCL	21362
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	31836
95% Approximate Gamma UCL	10143		
95% Adjusted Gamma UCL	11250		

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 31836

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Nickel

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	9.2	Minimum of Log Data	2.219
Maximum	33.5	Maximum of Log Data	3.512
Mean	17.45	Mean of log Data	2.792
Median	17.85	SD of log Data	0.378
SD	6.648		
Coefficient of Variation	0.381		
Skewness	0.765		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk Test Statistic	0.956
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	20.17	95% H-UCL	20.88
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	24.37
95% Adjusted-CLT UCL	20.32	97.5% Chebyshev (MVUE) UCL	27.36
95% Modified-t UCL	20.22	99% Chebyshev (MVUE) UCL	33.25

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	6.363	Data appear Normal at 5% Significance Level	
Theta Star	2.742		
nu star	229.1		
Approximate Chi Square Value (.05)	195	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	20.02
Adjusted Chi Square Value	192	95% Jackknife UCL	20.17
		95% Standard Bootstrap UCL	19.91
Anderson-Darling Test Statistic	0.337	95% Bootstrap-t UCL	20.62
Anderson-Darling 5% Critical Value	0.741	95% Hall's Bootstrap UCL	20.52
Kolmogorov-Smirnov Test Statistic	0.131	95% Percentile Bootstrap UCL	19.89
Kolmogorov-Smirnov 5% Critical Value	0.204	95% BCA Bootstrap UCL	20.25
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	24.27
		97.5% Chebyshev(Mean, Sd) UCL	27.23
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	33.04
95% Approximate Gamma UCL	20.49		
95% Adjusted Gamma UCL	20.81		

Potential UCL to Use		Use 95% Student's-t UCL	20.17

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

PCB(tot)

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.0589	Minimum of Log Data	-2.832
Maximum	2.312	Maximum of Log Data	0.838
Mean	0.593	Mean of log Data	-1.168
Median	0.331	SD of log Data	1.217
SD	0.669		
Coefficient of Variation	1.128		
Skewness	1.44		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk Test Statistic	0.93
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.867	95% H-UCL	1.566
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.483
95% Adjusted-CLT UCL	0.91	97.5% Chebyshev (MVUE) UCL	1.861
95% Modified-t UCL	0.876	99% Chebyshev (MVUE) UCL	2.603
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.791	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.75		
nu star	28.46		
Approximate Chi Square Value (.05)	17.29	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	0.853
Adjusted Chi Square Value	16.45	95% Jackknife UCL	0.867
		95% Standard Bootstrap UCL	0.841
Anderson-Darling Test Statistic	0.592	95% Bootstrap-t UCL	0.971
Anderson-Darling 5% Critical Value	0.771	95% Hall's Bootstrap UCL	0.897
Kolmogorov-Smirnov Test Statistic	0.17	95% Percentile Bootstrap UCL	0.858
Kolmogorov-Smirnov 5% Critical Value	0.21	95% BCA Bootstrap UCL	0.921
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.28
		97.5% Chebyshev(Mean, Sd) UCL	1.578
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.162
95% Approximate Gamma UCL	0.977		
95% Adjusted Gamma UCL	1.026		

Potential UCL to Use		Use 95% Approximate Gamma UCL	0.977

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Phenanthrene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	102.5	Minimum of Log Data	4.63
Maximum	137000	Maximum of Log Data	11.83
Mean	17101	Mean of log Data	7.172
Median	605.5	SD of log Data	2.187
SD	39163		
Coefficient of Variation	2.29		
Skewness	2.389		

Relevent UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.503	Shapiro Wilk Test Statistic	0.834
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	33159	95% H-UCL	167698
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	37272
95% Adjusted-CLT UCL	37838	97.5% Chebyshev (MVUE) UCL	49041
95% Modified-t UCL	34025	99% Chebyshev (MVUE) UCL	72160

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.264	Data do not follow a Discernable Distribution (0.05)	
Theta Star	64837		
nu star	9.495		
Approximate Chi Square Value (.05)	3.629	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	32284
Adjusted Chi Square Value	3.288	95% Jackknife UCL	33159
		95% Standard Bootstrap UCL	31791
Anderson-Darling Test Statistic	2.571	95% Bootstrap-t UCL	48941
Anderson-Darling 5% Critical Value	0.854	95% Hall's Bootstrap UCL	32423
Kolmogorov-Smirnov Test Statistic	0.335	95% Percentile Bootstrap UCL	32534
Kolmogorov-Smirnov 5% Critical Value	0.222	95% BCA Bootstrap UCL	37283
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	57337
		97.5% Chebyshev(Mean, Sd) UCL	74747
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	108945
95% Approximate Gamma UCL	44747		
95% Adjusted Gamma UCL	49388		

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 108945

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Pyrene

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	395	Minimum of Log Data	5.979
Maximum	97100	Maximum of Log Data	11.48
Mean	14949	Mean of log Data	7.708
Median	1096	SD of log Data	1.832
SD	30993		
Coefficient of Variation	2.073		
Skewness	2.07		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.525	Shapiro Wilk Test Statistic	0.79
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	27657	95% H-UCL	70944
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	31670
95% Adjusted-CLT UCL	30773	97.5% Chebyshev (MVUE) UCL	41168
95% Modified-t UCL	28251	99% Chebyshev (MVUE) UCL	59825
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.331	Data do not follow a Discernable Distribution (0.05)	
Theta Star	45180		
nu star	11.91		
Approximate Chi Square Value (.05)	5.168	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	26964
Adjusted Chi Square Value	4.748	95% Jackknife UCL	27657
		95% Standard Bootstrap UCL	26739
Anderson-Darling Test Statistic	2.621	95% Bootstrap-t UCL	35324
Anderson-Darling 5% Critical Value	0.831	95% Hall's Bootstrap UCL	23639
Kolmogorov-Smirnov Test Statistic	0.324	95% Percentile Bootstrap UCL	27641
Kolmogorov-Smirnov 5% Critical Value	0.219	95% BCA Bootstrap UCL	31783
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	45791
		97.5% Chebyshev(Mean, Sd) UCL	60589
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	87634
95% Approximate Gamma UCL	34450		
95% Adjusted Gamma UCL	37502		

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 87634

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Selenium

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	0.135	Minimum of Log Data	-2.004
Maximum	2.11	Maximum of Log Data	0.747
Mean	0.83	Mean of log Data	-0.385
Median	0.701	SD of log Data	0.687
SD	0.525		
Coefficient of Variation	0.632		
Skewness	1.11		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.046	95% H-UCL	1.247
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.483
95% Adjusted-CLT UCL	1.068	97.5% Chebyshev (MVUE) UCL	1.757
95% Modified-t UCL	1.051	99% Chebyshev (MVUE) UCL	2.297
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.256	Data appear Normal at 5% Significance Level	
Theta Star	0.368		
nu star	81.2		
Approximate Chi Square Value (.05)	61.44	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	1.034
Adjusted Chi Square Value	59.79	95% Jackknife UCL	1.046
		95% Standard Bootstrap UCL	1.032
Anderson-Darling Test Statistic	0.32	95% Bootstrap-t UCL	1.106
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL	1.09
Kolmogorov-Smirnov Test Statistic	0.127	95% Percentile Bootstrap UCL	1.037
Kolmogorov-Smirnov 5% Critical Value	0.205	95% BCA Bootstrap UCL	1.046
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.369
		97.5% Chebyshev(Mean, Sd) UCL	1.603
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.061
95% Approximate Gamma UCL	1.098		
95% Adjusted Gamma UCL	1.128		

Potential UCL to Use		Use 95% Student's-t UCL	1.046

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Vanadium

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18
Raw Statistics		**Log-transformed Statistics**	
Minimum	7.55	Minimum of Log Data	2.022
Maximum	30.5	Maximum of Log Data	3.418
Mean	16.68	Mean of log Data	2.732
Median	15	SD of log Data	0.422
SD	6.958		
Coefficient of Variation	0.417		
Skewness	0.631		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.933	Shapiro Wilk Test Statistic	0.964
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	19.53	95% H-UCL	20.49
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	24.12
95% Adjusted-CLT UCL	19.64	97.5% Chebyshev (MVUE) UCL	27.33
95% Modified-t UCL	19.57	99% Chebyshev (MVUE) UCL	33.63
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5.212	Data appear Normal at 5% Significance Level	
Theta Star	3.201		
nu star	187.6		
Approximate Chi Square Value (.05)	156.9	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0357	95% CLT UCL	19.38
Adjusted Chi Square Value	154.2	95% Jackknife UCL	19.53
		95% Standard Bootstrap UCL	19.32
Anderson-Darling Test Statistic	0.267	95% Bootstrap-t UCL	19.95
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL	19.63
Kolmogorov-Smirnov Test Statistic	0.117	95% Percentile Bootstrap UCL	19.35
Kolmogorov-Smirnov 5% Critical Value	0.204	95% BCA Bootstrap UCL	19.74
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	23.83
		97.5% Chebyshev(Mean, Sd) UCL	26.92
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	33
95% Approximate Gamma UCL	19.94		
95% Adjusted Gamma UCL	20.29		

Potential UCL to Use		Use 95% Student's-t UCL	19.53

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\ASE, INC\Kemron\Hamilton OH - NPL\BERA\Calcs\Pro UCL data.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Zinc

General Statistics

Number of Valid Observations	17	Number of Distinct Observations	16
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	35.5	Minimum of Log Data	3.57
Maximum	1380	Maximum of Log Data	7.215
Mean	332.6	Mean of log Data	5.327
Median	199	SD of log Data	0.995
SD	369.1		
Coefficient of Variation	1.11		
Skewness	1.871		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.743	Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	488.9	95% H-UCL	655.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	701.2
95% Adjusted-CLT UCL	523.2	97.5% Chebyshev (MVUE) UCL	864.2
95% Modified-t UCL	495.7	99% Chebyshev (MVUE) UCL	1184

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.012	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	328.7		
nu star	34.4		
Approximate Chi Square Value (.05)	21.99	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0346	95% CLT UCL	479.8
Adjusted Chi Square Value	20.95	95% Jackknife UCL	488.9
		95% Standard Bootstrap UCL	475.7
Anderson-Darling Test Statistic	0.595	95% Bootstrap-t UCL	612.4
Anderson-Darling 5% Critical Value	0.762	95% Hall's Bootstrap UCL	556.3
Kolmogorov-Smirnov Test Statistic	0.175	95% Percentile Bootstrap UCL	482.7
Kolmogorov-Smirnov 5% Critical Value	0.214	95% BCA Bootstrap UCL	535.3
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	722.8
		97.5% Chebyshev(Mean, Sd) UCL	891.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1223
95% Approximate Gamma UCL	520.4		
95% Adjusted Gamma UCL	546.2		

APPENDIX F
SITE-SPECIFIC BACKGROUND EVALUATION, 2008

Appendix F
Background Evaluation for Soil

As part of the uncertainty evaluation for the HHRA for the former ARMCO Hamilton Site, a statistical analysis of soil data was conducted to determine whether or not concentrations of specific COPCs in the exposure areas evaluated in the HHRA are consistent with concentrations in background samples. In accordance with USEPA guidance (USEPA, 2002b), the CERCLA program does not require clean up to concentrations below natural or anthropogenic background levels.

The background comparison was conducted in accordance with the USEPA *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA, 2002a), and as documented in responses to USEPA's comments on the draft HHRA. Comments were provided by USEPA on August 3, 2007 on the Draft HHRA for the former ARMCO Hamilton Site. The comments requested clarification of techniques used to conduct the statistical analysis used in the 2006 draft HHRA in light of technical guidance (USEPA, 2007a) and updated ProUCL software (version 4.00.02; USEPA, 2007b) published after the submittal of the Draft HHRA. In the Response to Comments (included as Appendix K of the Final HHRA), AK Steel clarified the process and assumptions, and USEPA agreed to allow the statistical evaluation from the Draft HHRA to be finalized as is for AOCs where no additional data were to be collected (AOC 1, AOC 2, AOC 18/21, AOC 19 and Block A). Statistical analysis of AOCs where new soil data were collected (AOC 13, Southern Parcel, and AOC 22 – a new area not included in the draft RI or draft HHRA) would be conducted using ProUCL 4.00.02, consistent with guidance provided by USEPA (2007a) to support the software. In addition, for a couple of key inorganics (arsenic and lead), the background evaluation was performed for subsurface soil as well as surface soil. In general, the statistical evaluation presented in the Addendum follows the same theories as that presented in the Draft HHRA. Subtle differences include the specific test selected and treatment of non-detected values.

I.1 Data Sets Used in the Statistical Evaluation

This section provides an overview of the approach and statistical calculations performed. Additional details concerning the calculations are provided in Section I.2.

As described in the U.S. EPA's (2002) *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* and consistent with the U.S. EPA-approved Work Plan (ENSR, 2005), sampling station locations were selected following a "Targeted Sampling Design" where prior knowledge of site-related factors were incorporated into the process of station location. The targeted sampling design was developed to meet the following criteria:

- Sampling stations were selected that were representative of the defined area of interest; and

- Stations with similar physical characteristics were selected to minimize the sampling error, as described in the study data quality objectives (DQO) process (U.S. EPA, 2001b).

As part of the RI/FS program, twelve background surface soil samples and nine background subsurface soil samples were collected from areas that have not been influenced by current or previous site activities and are similar in basic characteristics to the soil at the site. These samples are identified in Table 3-6 of the HHRA report. Sections 2.10 and 4.28 of the Draft RI/FS Report (ENSR, 2006) discuss the background soil sampling and analysis performed for the Site.

Surface soil data for the Site were divided into the human health exposure areas evaluated in the HHRA, as described in Section 5.3 of the HHRA report:

- AOC 1 – Sludge laydown area;
- AOC 2 – Closed landfill;
- AOC 18 and AOC 21 (On-site portion of former COG pipeline and Wooded area);
- AOC 19 (Off-site portion of former COG pipeline);
- Block A – Slag piles;
- Southern Parcel (excluding AOC 13);
- AOC 13; and
- AOC 22 (Riparian Area).

Each exposure area was compared to background separately. The details of the statistical methods are discussed in the following section, followed by the results of the analyses. The results for the Southern Parcel, AOC 13, and AOC 22 (Riparian Area), are provided in an Addendum that comes at the end of this Appendix.

I.2 Statistical Analysis Methods for AOC 1, AOC 2, AOC 18/21, AOC 19 and Block A

Chemical Selection for Background Evaluation

Surface soil samples collected from the former ARMCO Hamilton site and surrounding background sites were analyzed for an extensive list of constituents. Statistical calculations were performed for a subset of the chemicals detected in soil at AOC 1, AOC 2, AOC 18/21, AOC 19 and Block A. The chemicals included in the background evaluation were those identified in the HHRA results to be the primary risk drivers in surface soil. The following chemicals were considered in the background evaluation: aluminum, antimony, arsenic, iron, manganese, mercury, vanadium, and benzo(a)pyrene toxic equivalents (BaP-TE). Antimony was not detected in the background samples, therefore was not included in the statistical evaluation.

Treatment of Non-Detects

Because the datasets that included a large percentage of non-detects were excluded, the non-detect values in the remaining data sets were assumed not to introduce significant statistical bias. Therefore, all non-detect values were replaced with ½ the value of the sample quantitation limit (SQL) for the purposes of calculating the statistics. Where ½ the SQL was greater than the highest detected concentrations, the sample results for the non-detect were eliminated from the analysis.

Tests for Normality

Each constituent in each dataset was tested to determine whether the data were normally or lognormally distributed. The Shapiro-Wilk's test was used for this determination (α=0.10). To evaluate a lognormal distribution, the data were transformed by calculating the natural logarithm of each concentration. If both untransformed and log-tranformed data were normally distributed, untransformed data were selected for the analysis. Generalized statistical references describing the various methods are listed in the references at the end of this appendix.

Parametric Comparison of Means

For any individual chemical, where both the exposure area and background dataset distributions were normal or lognormal, the Student's t-test (α= 0.10) was used to compare the exposure area mean to the background mean. The variances of each paired dataset were calculated, and compared using an F-test (α=0.10). The t-test for either equal or unequal variance was used, as appropriate. For the lognormally distributed data sets, all calculations were performed on the log-transformed data.

Non-Parametric Comparison of Populations

For any individual chemical, if the distribution of either the exposure area or background datasets was neither normally nor lognormally distributed, or if the distributions were mixed, then a non-parametric comparison was necessary. The Wilcoxon Rank-Sum Test (also known as the Mann-Whitney U Test) was used for the non-parametric comparison (α=0.10).

Hypothesis Testing

The surface soil data from each exposure area was evaluated against background data using statistical Background Test Form 2 from the U.S. EPA *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (U.S. EPA, 2002a). Background Test Form 2 requires a strict burden of proof by selecting the null hypothesis that the chemical concentration in potentially contaminated areas exceeds background by more than a substantial difference S ($\Delta > S$). This approach favors the protection of the environment (U.S. EPA, 2002a). A significant difference (S) of one standard deviation (1sd) of the background dataset was selected to provide a reasonable ability to distinguish differences between datasets. If background data were normally or lognormally distributed, S was calculated as 1sd, with sd calculated in log-space for lognormally distributed data. If the background data were neither normally nor lognormally distributed, a percentile value was calculated equivalent to the mean plus one standard deviation in a normally distributed data set (84.13th percentile). The S for nonparametric tests was determined as the difference between the 84.13th percentile and the median (50th percentile).

Figure I-1 provides a graphical depiction of the test selection criteria. The specific statistical tests performed, and the S selected, are specified in Tables I-1a-e. The specific hypotheses to be used in the statistical evaluation are as stated in Test Form 2 (USEPA, 2002a):

H_o: The mean of the contaminant concentration in the exposure area dataset is greater than or equal to the mean of the background dataset by S (Δ > S) where, S = 1sd of the upstream data set ($u_{site} \geq u_{back}$+S).

H_A: The mean of the contaminant concentration in the exposure area dataset does not exceed the mean of the background dataset by S ($\Delta \leq$ S)($u_{site} < u_{back}$+S).

If the null hypothesis H_0 is rejected, it can be concluded with statistical significance that the mean of the exposure area data set is not significantly greater than the mean of the background dataset, or that, in general, the exposure area is consistent with background. If the null hypothesis is not rejected, it was assumed that the mean from the exposure area dataset may be greater than the mean of the background dataset, although this is not a statistically significant conclusion. This hypothesis was tested at the 0.10 level of significance (α = 0.10).

Evaluation of Power

The power represents the ability of the test to reject the null hypothesis; specifically, are there enough samples to make it theoretically possible to reject the null hypothesis? Because of the structure of the null hypothesis (U.S. EPA Test Form 2), insufficient power may result in a Type II error, the incorrect acceptance of the null hypothesis, that the exposure area data are greater than the background data. A power of 80-90% is the intended target for the statistical comparisons.

For the parametric t-tests, the power of each comparison was calculated. These results can be used to aid the interpretation of statistical results, and may be useful to identify data gaps. Power was not calculated for non-parametric Wilcoxon Rank Sum tests. Although power has not been calculated for the non-parametric Wilcoxon Rank Sum tests, the rejection of the null hypothesis indicates that power was sufficient.

I.3 Results of Statistical Analyses for AOC 1, AOC 2, AOC 18/21, AOC 19 and Block A

The statistical software Stata 8.2 was used to perform the statistical calculations. Raw results from the Stata 8.2 program are attached to this Appendix. The distributions of the constituents from the site and background datasets are presented in Tables I-1a-e. The results indicate a mixture of normally, lognormally, and not normally distributed data.

AOC1 vs. Background

In the AOC1 vs. Background evaluation, parametric tests were run using untransformed data for aluminum and vanadium, parametric tests were run using log-transformed data for manganese and B(a)P TE. Non-parametric tests were run for the remaining 3 constituents, including arsenic, iron, and mercury. The step-by-step summary of the statistical results is presented in Table I-1a.

The null hypothesis was rejected for one parametric t-test (B(a)P-TE, log-transformed data) and two non-parametric Wilcoxon Rank Sum tests (arsenic and mercury), indicating concentrations for these constituents are consistent with the background dataset. For the remaining constituents, the null hypothesis was not rejected, indicating either the exposure area dataset is greater than the Background dataset, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power ranged from 11% to > 99%. The power was adequate to evaluate the log-transformed datasets for manganese and B(a)P - TE, however power was less than 70% in the evaluation of aluminum and vanadium.

AOC18_21 vs. Background

In the AOC18_21 vs. Background evaluation, parametric tests were run using untransformed data for aluminum and log-transformed data for vanadium. Non-parametric tests were run for the remaining five constituents, including arsenic, iron, manganese, mercury, and B(a)P-TE. The step-by-step summary of the statistical results is presented in Table I-1b.

The null hypothesis was rejected for four non-parametric Wilcoxon Rank Sum tests (arsenic, iron, mercury, and B(a)P-TE), indicating concentrations for these constituents in AOC18_21 are consistent with Background. For the remaining three constituents, the null hypothesis was not rejected, indicating either the constituent concentrations in the AOC18_21 dataset are greater than the Background dataset, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power ranged from 13% (vanadium) to 94% (aluminum), so power is likely to be insufficient for the evaluation of vanadium.

AOC19 vs. Background

In the AOC19 vs. Background evaluation, parametric tests were run using untransformed data for aluminum and vanadium, parametric tests were run using log-transformed data for manganese and B(a)P-TE. Non-parametric tests were run for the remaining three constituents, including arsenic, iron, and mercury. The step-by-step summary of the statistical results is presented in Table I-1c.

The null hypothesis was rejected for three non-parametric Wilcoxon Rank Sum tests (arsenic, iron, and mercury), indicating concentrations for these constituents in AOC19 are consistent with Background.

The null hypothesis was also rejected for the two parametric tests using log-transformed data (manganese and B(a)P-TE). For the remaining two constituents, the null hypothesis was not rejected, indicating either the constituent concentrations in the AOC19 dataset are greater than the Background dataset, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power ranged from 15% to 99%, with power likely insufficient to evaluate aluminum and vanadium.

AOC2 vs. Background

In the AOC2 vs. Background evaluation, parametric tests were run using untransformed data for aluminum and vanadium, and parametric tests were run using log-transformed data for arsenic, manganese, and B(a)P-TE. Non-parametric tests were run for the remaining two constituents, including iron, and mercury. The step-by-step summary of the statistical results is presented in Table I-1d.

The null hypothesis was rejected for the two non-parametric Wilcoxon Rank Sum tests (iron, and mercury), indicating concentrations for these constituents in AOC2 are consistent with Background. The null hypothesis was also rejected for two parametric tests using log-transformed data (arsenic and B(a)P-TE). For the remaining three constituents, the null hypothesis was not rejected, indicating either the constituent concentrations in the AOC2 dataset are greater than the Background dataset, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power ranged from 34% to > 99%, with power likely insufficient to evaluate aluminum, manganese, and vanadium.

Block A vs. Background

In the Block A vs. Background evaluation, parametric tests were run using log-transformed data for arsenic, manganese, and vanadium. Non-parametric tests were run for the remaining four constituents, including aluminum, iron, mercury, and B(a)P-TE. The step-by-step summary of the statistical results is presented in Table I-1e.

The null hypothesis was rejected for the two non-parametric Wilcoxon Rank Sum tests (mercury and B(a)P-TE), indicating concentrations for these constituents in Block A are consistent with Background. The null hypothesis was also rejected for one parametric test using log-transformed data (arsenic). For the remaining four constituents, the null hypothesis was not rejected, indicating either the constituent concentrations in the Block A dataset are greater than the Background dataset, or that the test did not have sufficient power to recognize a difference. Examination of power calculations, where available (t-tests), indicates power ranged from 13% (vanadium) to 100%, with power likely insufficient to evaluate vanadium.

Summary of Data Comparisons

Based on the evaluation of the five exposure areas compared to background, it could not be ruled out (i.e., the null hypothesis could not be rejected) that the surface soil concentrations of aluminum and vanadium in all five exposure areas may exceed Background by more than S. Surface soil concentrations of manganese may exceed Background by more than S in four of the five exposure areas. Manganese is consistent with Background in AOC 19. Surface soil concentrations of iron may exceed Background by more than S in two of five areas. Iron is consistent with Background in AOC 2, AOC18_21, and AOC 19. Surface soil concentrations of arsenic, mercury and B(a)P-TE are consistent with Background in all five areas.

I.4 Uncertainties

In general, the statistical analysis was conducted in order to reduce uncertainties in the HHRA evaluation of surface soil at the former ARMCO Hamilton site. However, there are specific uncertainties associated with the statistical analysis. None of the datasets assessed in the statistical evaluation were quantitatively examined for outliers. In general, the presence of outliers would tend to make two different groups of data look different, when they in fact might be more similar if the outlier(s) were to be omitted.

Where the Background data were normally distributed, S was defined as one standard deviation, regardless of the test used to compare to other data sets. For all tests where the Background data were not normally distributed, a non-parametric test was used and a non-parametric S was calculated. The value selected for S (the difference between the median and the 84.13th percentile of the data) is equivalent to one standard deviation above the mean in a normally distributed data set. One standard deviation was selected for ease of statistical implementation and may or may not have significance from a human health risk perspective in the HHRA.

I.5 Conclusions for AOC 1, AOC 2, AOC 18/21, AOC 19 and Block A

This statistical evaluation compared the concentration of specific constituents in surface soil in five exposure areas to site-specific Background surface soil concentrations. The results of this statistical evaluation indicate that aluminum and vanadium were not consistent with background at all five exposure areas, concentrations of manganese were not consistent with background at four exposure areas, and that concentrations of iron were not consistent with background at two of the five exposure areas. Arsenic, mercury, and B(a)P-TE were found to be consistent with background at all five exposure areas.

I.6 References

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Walpole, Ronald E. and Raymond H. Myers. 1989. Probability and Statistics for Engineers and Scientists. New York: Macmillan Publishing Company.

I.7 Addendum: Soil Background Evaluation

This addendum to Appendix I augments the background statistical evaluation described above. In addition to presenting the statistical analysis using the new soil data for AOC 13, Southern Parcel, and AOC 22 (Riparian Area), results are presented for arsenic and lead in combined surface and subsurface soil in all exposure areas. Based on the risk results, inorganics in subsurface soil are generally not risk drivers. However, because of the influence of background levels of arsenic on risk results, a background evaluation was also performed for arsenic in all areas. Lead was also identified as an inorganic of interest in combined soil for some areas (e.g., AOC 1), and was therefore included in the combined surface and subsurface soil background evaluation. To be consistent with the combined soil exposure point concentrations used in the HHRA, surface and subsurface background samples were combined for the background evaluation. The updated background statistical evaluation presented in this addendum was performed using ProUCL 4.00.02, consistent with AK Steel's discussions with USEPA (see Response to Comments in Appendix K) and in accordance with guidance provided by USEPA (2007a) to support the software.

I.8 Data Sets Used in the Updated Statistical Evaluation

In July 2008, new soil data were collected at AOC 13, AOC 22 (Riparian Area), and Southern Parcel. No new data were collected for the background soil. All soil samples for both the Site and background data were divided into two data sets: surface soil and subsurface soil. Consistent with the soil depth classification scheme used in the HHRA, samples with a depth of less than or equal to 2 feet below ground surface were classified as surface soil whereas deeper soil (i.e., greater than 2 feet below ground surface) were classified as subsurface soil. The combined soil data set consisted of all soil samples, surface and subsurface. The following comparisons were statistically analyzed:

<u>Surface Soil:</u>

- AOC 13 vs. Background
- AOC 22 (Riparian Area) vs. Background
- Southern Parcel vs. Background

<u>Combined Soil:</u>

- AOC 1 vs. Background
- AOC 2 vs. Background
- AOC 18 and 21 vs. Background
- AOC 19 vs. Background
- Block A vs. Background
- AOC 13 vs. Background
- Southern Parcel vs. Background

A "combined soil" evaluation was not performed for AOC 22 (Riparian Area) because AOC 22 samples were collected at depths of less than or equal to 2 feet and were therefore classified as surface soil.

I.9 Chemical Selection

Only a subset of the chemicals that were detected in the soil samples collected from the former ARMCO Hamilton site were analyzed in this statistical evaluation. Chemicals included in this background evaluation were those identified in the revised HHRA results to be the primary risk drivers in either the surface soil or combined soil pathways. For surface soil the following chemicals were evaluated: Aluminum, Arsenic, Iron, Lead, Manganese, Vanadium, and B(a)P-TE. For combined soil, Arsenic and Lead were evaluated.

I.10 Updated Statistical Analysis Methodology

USEPA (2002a) Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites was used as the primary source for the development of the methodology used in this evaluation. ProUCL version 4.00.02 (USEPA, 2007b) is statistical software that uses as its basis for background evaluations USEPA (2002a) Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites. The USEPA ProUCL Technical Guide (USEPA, 2007a) was used as a reference for selection of specific statistical tests, based on the attributes of the data sets. The output files from the ProUCL software are included in Attachments 1 through 3. Goodness-of-Fit statistics are included in **Attachment I-1a** and **I-1b** (surface soil and combined soil) and hypothesis test results are included in **Attachment I-2a** and **I-2b** (surface soil and combined soil).The statistical software package Stata (Stata Corporation, 2003) was used to calculate the 84.13th and 50th percentiles needed to calculate the Substantial Difference (S), details below. Raw results from the Stata program are included in **Attachment I-3a** and **I-3b** (surface soil and combined soil).

Two-sample hypothesis testing was used to compare the Site data set to the background data set. All statistical tests, including the GOF statistics and two-sample hypothesis tests, were run at 90% confidence.

Null and Alternate Hypotheses

Consistent with USEPA (2002; 2007a), two hypothesis tests were used in this evaluation: Test Form 1 and Test Form 2. The null hypothesis for Test Form 1 states that there is not a statistically significant difference between the means of the Site and background data. Test Form 2 requires a strict burden of proof to prove the Site is consistent with background by selecting a null hypothesis that the Site mean exceeds the background mean by more than a Substantial Difference (S)[1]. Therefore, while

[1] The calculation of S is explained in the next section.

Test Form 1 uses a more conservative investigative level of $\Delta = 0$ (i.e., does not allow for S), it has a more relaxed burden of proof than Test Form 1.

The Quantile test uses Test Form 1. The hypotheses used for Test Form 1 are:

- H_O: The mean of the Site data set is less than or equal to the mean of the background data set. ($\mu_{Site} \leq \mu_{background}$)
- H_A: The mean of the Site data set is greater than the mean of the background data set. ($\mu_{Site} > \mu_{background}$)

The Student's and Satterthwaite's t-tests, the Wilcoxon Mann-Whitney (WMW) test and the Gehan test use Test Form 2 (USEPA, 2002). The hypotheses used for Test Form 2 are:

- H_O: The mean of the Site data set is greater than or equal to the mean of the background data set. ($\mu_{Site} \geq \mu_{background} + S$)
- H_A: The mean of the Site data set is less than the mean of the background data set. ($\mu_{Site} < \mu_{background} + S$)

Calculation of the Substantial Difference (S)

S is the Substantial Difference and is used in the hypotheses for Test Form 2 (USEPA, 2002, 2007a). Consistent with the statistical evaluation presented in the Draft HHRA, S used in this evaluation was equal to one standard deviation (SD) in the background data set. S was calculated in the following manner:

- S was calculated as 1 SD only if both the Site and Background data sets had a frequency of detection (FOD) of 100% and the Background was normally distributed.
- In all other cases, statistical were calculated using nonparametric techniques, and 1 SD was approximated by the difference between the 84.13th and the 50th percentiles. The 84.13th percentile of the data approximates one standard deviation of a data set. On a normal curve, the arithmetic mean plus 1 SD corresponds to the 84.13th percentile of a data set.

Statistical Analysis Procedure

Table I-2a and **Table I-2b** provide a step-by-step presentation of the background evaluation for surface soil and combined soil, respectively. This section provides a detailed explanation of the methodology used. **Figure I-2** also presents a graphical depiction of the test selection process. The test selection process and data analysis follow USEPA (2007a) guidance.

Validity of Background Evaluation

Two sample hypothesis testing was conducted for data sets with greater than 8 detected results. If either the Site or background data set had less than 8 samples, no statistical evaluation was conducted.

Statistical Test Selection

Two parametric tests, the Satterthwaite's and Student's t-tests, and three non-parametric tests, the Quantile test, the WMW test, and the Gehan test were used to compare the Site and background data. In order to select the appropriate test, several characteristics of the data sets were reviewed, including the FOD, detection limits of the any non-detect results, and the distribution, or GOF, of each data set. The distribution was analyzed by ProUCL GOF tests and the data set was concluded to normally distributed or not normally distributed (with 90% confidence). The ProUCL GOF test output is in **Attachment I-1a and I-1b**.

The Quantile test, using Test Form 1, was used to initially to evaluate all comparisons. If the null hypothesis was rejected and the Site mean was concluded to be greater than the background mean, no other statistical tests were calculated. If the null hypothesis was not rejected, then one of tests using Test Form 2 was selected. The Quantile test focuses on the right tails of the data sets and therefore can have more power to detect a difference than the two-sample t-test, the WMW or the Gehan test (USEPA, 2007b). More details on the statistical test conclusions are detailed in the next section.

Figure I-2 provides a graphical depiction of the test selection criteria. The specific criteria that determine the selection of the second statistical test (if necessary after the Quantile test results) are outlined below:

<u>Parametric 2-Sample t-Tests:</u>

- A parametric 2-sample t-test was used if the Site and Background both had FOD of 100% and if both Site and background were normally distributed.
- An F-test was conducted using ProUCL to determine the variance's of the Site and the background data set. If the variances are equal the Student's t-test is used. Satterthwaite's t-test is used if the variances are unequal.

<u>Nonparametric WMW Test:</u>

- The WMW was selected in two scenarios:
    1. If the FOD is 100 % for both Site and background and either Site or background is not normally distributed.

2. If the FOD is less than 100% but greater than 60% and the detection limits for both data sets are equal.

Nonparametric Gehan Test:

- The Gehan Test is used in two scenarios:

  1. If the FOD is less than 100% but greater than 60% and there are multiple detection limits in the two data sets.

  2. If the FOD is less than 60%.

Evaluation of Statistical Test Results

For the t-tests and the Gehan test, the null hypothesis was rejected if the calculated p-value was less than 0.1. The confidence level for the WMW test was also set at 0.1, consistent with the test design described above. Because the WMW test results output only provides an approximate p-value, it was determined that the decision whether or not to reject the null hypothesis would be based not on calculated p-value, but using the WMW test statistics. If the calculated test statistic was less than the test critical value, the null hypothesis was rejected. For the Quantile test, although 90% confidence is selected, ProUCL uses an alpha approximated by lookup tables without interpolation. The null hypothesis was then rejected or not rejected based on the results in the ProUCL output. The results of all the two-sample hypothesis tests are provided in **Attachment I-2a** (surface soil) and **Attachment I-2b** (combined soil).

As discussed in the preceding section, the Quantile test was the only statistical test run for all comparisons. The rejection of the null hypothesis in Test Form 1 indicates that the Site mean is greater than the background mean at a conservative investigation level ($\Delta = 0$). Therefore, no further tests were necessary when the Quantile test rejected the null hypothesis. In addition, this test focuses on the right tails of the data sets and therefore can have more power to detect a difference than the two-sample t-test, the WMW or the Gehan test (USEPA, 2007b).

If the Quantile test accepted the null hypothesis, additional tests using Test Form 2 (i.e., the t-tests, the WMW or the Gehan test) were used to compare the Site and background data sets. The null hypothesis in Test Form 2 requires a stricter burden of proof and is considered protective of human health and the environment (USEPA, 2007b).

I.11 Results of the Updated Statistical Analysis

Table I-3 provides a summary of the results of this updated statistical analysis for surface soil and combined soil in AOC 13, Southern Parcel and AOC 22, and for combined soil in AOC 1, AOC 2, AOC 18 and 21, AOC 19, Block A. The results for each exposure area are summarized below.

AOC 1 vs. Background

Only combined soil was analyzed in AOC 1. Arsenic and Lead, the only chemicals evaluated for this area, were both found to be consistent with background.

AOC 2 vs. Background

Only combined soil was analyzed in AOC 2. Arsenic and Lead, the only chemicals evaluated for this area, were both found to be consistent with background.

AOC 18 and 21 vs. Background

Only combined soil was analyzed for AOC 18 and 21. Arsenic and Lead, the only chemicals evaluated for this area, were both found to be consistent with background.

AOC 19 vs. Background

Only combined soil was analyzed for AOC 19. Arsenic and Lead, the only chemicals evaluated for this area, were both found to be consistent with background.

Block A vs. Background

Only combined soil was analyzed for Block A. Arsenic and Lead, the only chemicals evaluated for this area, were both found to be consistent with background.

AOC 13 vs. Background

In AOC 13 surface soil, Arsenic, Iron, Lead, Vanadium and B(a)P-TE were found to be consistent with background. In AOC13 combined soil, Arsenic and Lead were the only chemicals evaluated, and both were found to be consistent with background.

AOC 22 (Riparian Area) vs. Background

In AOC 22 surface soil, Aluminum, Arsenic, Iron, Lead, Vanadium, and B(a)P-TE were found to be consistent with Background. No evaluation of combined soil was performed for AOC 22 since no subsurface soil samples were collected.

Southern Parcel vs. Background

In Southern Parcel surface soil, Arsenic, Lead, and B(a)P-TE were found to be consistent with background. In Southern Parcel combined soil, Arsenic and Lead were the only chemicals evaluated, and both were found to be consistent with background.

I.12 Summary and Conclusions of All Background Evaluations

Table I-4 presents the results from the original and updated statistical analyses. **Table I-4** provides updated conclusions on whether the former ARMCO Hamilton site soil samples can be considered consistent with background soil samples. Based on these combined results, the following chemicals can be considered consistent with background and for which no further evaluation is necessary:

Chemicals Consistent with Background Surface Soil:

- AOC 1: Arsenic, Mercury, and B(a)P-TE
- AOC 2: Arsenic, Iron, Mercury and B(a)P-TE
- AOC 13: Arsenic, Iron, Lead, Vanadium, and B(a)P-TE
- AOC 18 and AOC 21: Arsenic, Iron, Mercury, and B(a)P-TE.
- AOC 19: Arsenic, Iron, Manganese, Mercury and B(a)P-TE
- AOC 22 (Riparian Area): Aluminum, Arsenic, Iron, Lead, Vanadium, and B(a)P-TE
- Block A: Arsenic, Mercury, B(a)P-TE
- Southern Parcel: Arsenic, Lead, and B(a)P-TE

Chemicals Consistent with Background Combined Soil:

- AOC 1: Arsenic and Lead
- AOC 2: Arsenic and Lead
- AOC 13: Arsenic and Lead
- AOC 18 and AOC 21: Arsenic and Lead
- AOC 19: Arsenic and Lead
- Block A: Arsenic and Lead
- Southern Parcel: Arsenic and Lead

I.13 References

United States Environmental Protection Agency (USEPA), 2007a. ProUCL Version 4.0 Technical Guide.

United States Environmental Protection Agency (USEPA), 2007b. ProUCL Software. Version 4.00.02.

United States Environmental Protection Agency (USEPA). 2002a. Guidance for Comparing Background and Chemical Concentration sin Soil for CERCLA Sites. EPA 540-R-01-003. OSWER 9285.7-41. September 2002.

USEPA. 2002b. Transmittal of Policy Statement: "Role of Background in the CERCLA Cleanup Program" OSWER 9285.6-07P. Michael Cook, Director, Office of Emergency and Remedial Response. Signed May 1, 2002.

Stata Corporation, 2003. Stata Software for Statistics and Data Analysis.

Table I-1a
Results of Surface Soil Statistical Analysis
Former ARMCO Hamilton Site
AOC1
S = One standard deviation
S = 84.13% non-parametric not normal tests

Chemical	Distributions[a]			Tests to Run			Parametric Tests Normal Distribution				Parametric Tests Log-normal distribution				Non-parametric Tests		Results	Is AOC1 consistent with Background?
				Parametric t-test		Non-parametric Wilcoxon rank sum test	Test for homogeneity of variance		t-test p-value (a, B)	power	Test for homogeneity of variance		t-test p-value (a, B)	power				
	AOC1	Background	S	Raw data	Log-trans. data		F-test p-value	t-test used			F-test p-value	t-test used			p-value	z-score		
Aluminum	N + LN	N + LN	sigma	Yes			0.0002	unequal	0.9577	0.9954							Do not reject Ho	No
Arsenic	N	LN	84.13%			Yes									0.0000	4.398	Reject Ho	Yes
Iron	N + LN	–	84.13%			Yes									0.0323	-2.140	Do not reject Ho	No
Manganese	N + LN	LN	84.13%		Yes						0.8990	equal	0.9995	0.9925			Do not reject Ho	No
Mercury	LN	–	84.13%			Yes									0.0000	4.437	Reject Ho	Yes
Vanadium	N	N + LN	sigma	Yes			0.4102	equal	0.4753	0.1121							Do not reject Ho	No
B(a)P TE	LN	LN	84.13%		Yes						0.0184	unequal	0.0011	0.9955			Reject Ho	Yes

(a) N indicates normal distribution, LN indicates log-normal distribution, – indicates distribution not normal
S = One standard deviation (normal and log-normal distributions)
S = 84.13% (not normal distributions)
Null hypotheses rejected if p-value < 0.10 for f-tests and t-tests
Null hypotheses rejected if p-value < 0.10 and z-score < 0 for WRS tests
p-values that are significant (i.e., <0.10) are bolded.
z-scores that are significant (i.e., <0) are bolded.

Table [illegible]
Results of Surface Soil Statistical Analysis
Former ARMCO Hamilton Site
AOC18_21
S = One standard deviation
S = 84.13% non-parametric not-normal tests

Chemical	Distribution[a]			Tests to Run			Parametric Tests (Normal) Distribution				Parametric Tests (Log-normal distribution)				Non-parametric Tests		Results	Is AOC18 & 21 consistent with Background?
				Parametric t-test		Non-parametric	Test for homogeneity of variance		t-test	power	Test for homogeneity of variance		t-test	power				
	AOC18 & 21	Background	S	Raw data	Log-trans. data	Wilcoxon rank sum test	F-test p-value	t-test used	p-value (a, 0)		F-test p-value	t-test used	p-value (a, 0)		p-value	z-score		
Aluminum	LN	N + LN	sigma		Yes						0.4083	equal	0.9893	0.7429			Do not reject Ho	No
Arsenic	N	LN	84.13%			Yes									0.0000	4.641	Reject Ho	Yes
Iron	N + LN	–	84.13%			Yes									0.0005	3.466	Reject Ho	Yes
Manganese	–	LN	84.13%			Yes									0.7412	-0.230	Do not reject Ho	No
Mercury	–	–	84.13%			Yes									0.0000	4.572	Reject Ho	Yes
Vanadium	N + LN	N + LN	sigma	Yes			0.1010	equal	0.5478	0.1264							Do not reject Ho	No
B(a)P TE	–	LN	84.13%			Yes									0.0000	4.144	Reject Ho	Yes

[a] N indicates normal distribution, LN indicates log-normal distribution, – indicates distribution not normal
S = One standard deviation (normal and log-normal distributions)
S = 84.13% (not normal distributions)
Null hypotheses rejected if p-value < 0.10 for F-tests and t-tests
Null hypotheses rejected if p-value < 0.10 and z-score < 0 for WRS tests
p-values that are significant (i.e., <0.10) are bolded.
z-scores that are significant (i.e., <0) are bolded.

Table I-1c
Results of Surface Soil Statistical Analysis
Former ARMCO Hamilton Site
ADC19
S = One standard deviation
S = 84.13% non-parametric not-normal tests

Chemical	Distribution[a]			Tests to Run			Parametric Tests Normal Distribution				Parametric Tests Log-normal distribution				Non-parametric Tests		Results	Is ADC19 consistent with Background?
				Parametric t-test		Non-parametric Wilcoxon rank sum test	Test for homogeneity of variance		t-test p-value in B	power	Test for homogeneity of variance		t-test p-value in B	power				
	ADC19	Background	S	Raw data	Log-trans. data		F-test p-value	t-test used			F-test p-value	t-test used			p-value	z-score		
Aluminum	N + LN	N + LN	sigma	Yes			0.9507	equal	0.2912	0.2345							Do not reject Ho	No
Arsenic	--	LN	84.13%			Yes									0.0005	3.506	Reject Ho	Yes
Iron	N + LN	--	84.13%			Yes									0.0002	3.737	Reject Ho	Yes
Manganese	N + LN	LN	84.13%		Yes						0.4661	equal	0.0035	0.9406			Reject Ho	Yes
Mercury	LN	--	84.13%			Yes									0.0136	2.468	Reject Ho	Yes
Vanadium	N + LN	N + LN	sigma	Yes			0.5779	equal	0.5890	0.1466							Do not reject Ho	No
B(a)P TE	LN	LN	84.13%		Yes						0.1539	equal	0.0012	0.9789			Reject Ho	Yes

(a) N indicates normal distribution, LN indicates log-normal distribution, -- indicates distribution not normal
S = One standard deviation (normal and log-normal distributions)
S = 84.13% (not normal distributions)
Null hypotheses rejected if p-value < 0.10 for f-tests and t-tests
Null hypotheses rejected if p-value < 0.10 and z-score < 0 for WRS tests
p-values that are significant (i.e., <0.10) are bolded.
z-scores that are significant (i.e., <0) are bolded.

Table [illegible]
Results of Surface Soil Statistical Analysis
Former AMSCO Hamilton Site
AOC3
S = One standard deviation
S = 84.13% non-parametric not-normal tests

Chemical	Distributions[a]			Tests to Run			Parametric Tests Normal Distribution				Parametric Tests Log-normal distribution				Non-parametric Tests		Results	Is AOC3 RA consistent with Background?
				Parametric t-test		Non-parametric Wilcoxon rank sum test	Test for homogeneity of variance		t-test p-value (a, β)	power	Test for homogeneity of variance		t-test p-value (a, β)	power				
	AOC3 RA	Background	S	Raw data	Log-trans. data		F-test p-value	t-test used			F-test p-value	t-test used			p-value	z-score		
Aluminum	N + LN	N + LN	sigma	Yes			0.0169	unequal	0.8534	0.4279							Do not reject Ho	No
Arsenic	N + LN	LN	84.13%		Yes						0.0332	unequal	0.0017	0.9893			Reject Ho	Yes
Iron	--	--	84.13%			Yes									0.0167	2.394	Reject Ho	Yes
Manganese	N + LN	LN	84.13%		Yes						0.3747	equal	0.6451	0.1616			Do not reject Ho	No
Mercury	--	--	84.13%			Yes									0.0001	3.882	Reject Ho	Yes
Vanadium	N + LN	N + LN	sigma	Yes			0.2761	equal	0.1302	0.4436							Do not reject Ho	No
B(a)P TE	LN	LN	84.13%		Yes						0.8614	equal	0.0084	0.9309			Reject Ho	Yes

[a] N indicates normal distribution, LN indicates log-normal distribution, -- indicates distribution not normal
S = One standard deviation (normal and log-normal distributions)
S = 84.13% (not normal distributions)
Null hypotheses rejected if p-value < 0.10 for f-tests and t-tests
Null hypotheses rejected if p-value < 0.10 and z-score < 0 for WRS tests
p-values that are significant (i.e., <0.10) are bolded.
z-scores that are significant (i.e., <0) are bolded.

Table I-1a
Results of Surface Soil Statistical Analysis
Former ARMCO Hamilton Site
Block A
S = One standard deviation
S = 84.13% non-parametric not normal tests

Chemical	Distributions[a]			Tests to Run			Parametric Tests Normal Distribution				Parametric Tests Log-normal distribution				Non-parametric Tests		Results	Is Block A consistent with Background?
				Parametric t-test		Non-parametric Wilcoxon rank sum test	Test for homogeneity of variance		t-test p-value (α, β)	power	Test for homogeneity of variance		t-test p-value (α, β)	power				
	Block A	Background	S	Raw data	Log-trans. data		F-test p-value	t-test used			F-test p-value	t-test used			p-value	z-score		
Aluminum	--	N + LN	sigma			Yes									0.0007	-3.399	Do not reject Ho	No
Arsenic	LN	LN	84.13%		Yes						0.4644	equal	0.0000	1.0000			Reject Ho	Yes
Iron	LN	--	84.13%			Yes									0.5506	0.597	Do not reject Ho	No
Manganese	N + LN	LN	84.13%		Yes						0.4176	equal	1.0000	1.0000			Do not reject Ho	No
Mercury	--	--	84.13%			Yes									0.0000	4.457	Reject Ho	Yes
Vanadium	LN	N + LN	sigma		Yes						0.5720	equal	0.1832	0.3685			Do not reject Ho	No
B(a)P TE	--	LN	84.13%			Yes									0.0002	3.763	Reject Ho	Yes

(a) N indicates normal distribution, LN indicates log-normal distribution, -- indicates distribution not normal
S = One standard deviation (normal and log-normal distributions)
S = 84.13% (not normal distributions)
Null hypotheses rejected if p-value < 0.10 for f-tests and t-tests
Null hypotheses rejected if p-value < 0.10 and z-score < 0 for WRS tests
p-values that are significant (i.e., <0.10) are bolded.
z-scores that are significant (i.e., <0) are bolded.

TABLE 14a
POPULATION COMPARISON - AOC 13, AOC 22 (RIPARIAN AREA) AND SOUTHERN PARCEL SURFACE SOIL v. BACKGROUND SURFACE SOIL
BACKGROUND EVALUATION
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

Notes:
DL - Detection Limit.
FOD - Frequency of Detection, Number of detected samples / Number of total samples.
H_A - Alternate Hypothesis.
H_0 - Null Hypothesis.
m - Background sample size.
n - Site sample size.
NC - Not calculated.
S - Substantial Difference.
SD - Standard Deviation.

TABLE I-3b
BACKGROUND EVALUATION - AOC 1, AOC 2, AOC18/21, AOC 16, BLOCK A, AOC 13 AND SOUTHERN PARCEL COMBINED SOIL v. BACKGROUND COMBINED SOIL
ADDENDUM TO STATISTICAL EVALUATION OF BACKGROUND SOIL
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

Constituent	Site			Background			Validity of Background Evaluation? (a)	Distribution (b)		Parametric or Non-Parametric Test (c)	DL Overlap (d)	Tests to Run (e)				Basis of S (f)	S	Test Results									Concentrations at Site Data Consistent with Background? (i)
																		Quantile Test Results (H0: Site <= Bkg)	WMW Test Results (H0: Site >= Bkg + S)				Gehan Test Results (H0: Site >= Bkg + S)				
	Number of Detects	n	% FOD	Number of Detects	m	% FOD		Site	Bkg			Quantile Test	1 Sample t-Test	WMW Test	Gehan Test			Reject H0 and Accept HA: Site > Bkg?	Test U-Stat	Critical Value	Reject H0 and accept HA: Site < Bkg + S?	Approximate p-value (g)	z Test Value	Critical z	Reject H0 and accept HA: Site < Bkg + S?	p-value (h)	
AOC 1																											
Arsenic	31	34	91	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	24	No					-6.091	-1.282	Yes	[illegible]	Yes
Lead	33	34	97	20	20	100	Run Tests			Non-Parametric	Equal	X		X		(84.13-50) th %	160	No	(j)	(j)	(j)	(j)	-3.279	-1.282	Yes	[illegible]	Yes
AOC 2																											
Arsenic	18	20	90	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	24	No					-6.41	-1.282	Yes	[illegible]	Yes
Lead	20	20	100	20	20	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	160	No	17	152	Yes	[illegible]					Yes
AOC 18 and 21																											
Arsenic	41	42	98	20	20	100	Run Tests			Non-Parametric	Equal	X		X		(84.13-50) th %	24	No	(j)	(j)	(j)	(j)	-4.335	-1.282	Yes	[illegible]	Yes
Lead	38	42	90	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	160	No					-4.338	-1.282	Yes	[illegible]	Yes
AOC 16																											
Arsenic	32	32	100	20	20	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	24	No	20	152	Yes	[illegible]					Yes
Lead	26	32	81	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	160	No					-4.687	-1.282	Yes	[illegible]	Yes
Block A																											
Arsenic	25	31	81	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	24	No					[illegible]	-1.282	Yes	[illegible]	Yes
Lead	29	31	94	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	160	No					[illegible]	-1.282	Yes	[illegible]	Yes
AOC 13																											
Arsenic	78	79	99	20	20	100	Run Tests			Non-Parametric	Equal	X		X		(84.13-50) th %	24	No	(j)	(j)	(j)	(j)	-4.784	-1.282	Yes	[illegible]	Yes
Lead	61	79	77	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	160	No					[illegible]	-1.282	Yes	[illegible]	Yes
Southern Parcel																											
Arsenic	227	240	95	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	24	No					-7.281	-1.282	Yes	[illegible]	Yes
Lead	228	240	95	20	20	100	Run Tests			Non-Parametric	Multiple	X			X	(84.13-50) th %	160	No					[illegible]	-1.282	Yes	[illegible]	Yes

Notes:
BAP-TE - Benzo(a)Pyrene Toxicity Equivalent.
DL - Detection Limit.
FOD - Frequency of Detection. Number of detected samples / Number of total samples.
H_A - Alternate Hypothesis.
H_0 = - Null Hypothesis.
m - Background sample size.
n - Site sample size.
NC - Not calculated.
S - Substantial Difference.
SD - Standard Deviation
WMW - Wilcoxon-Mann-Whitney Test.
(a) Hypothesis tests were not calculated if either the site or background data sets have less than 8 detected results.
(b) Distribution determined by ProUCL Goodness of Fit Test Statistics. Distribution was only analyzed if both the Site and Background data sets have FODs of 100%.
(c) If both the site and background data sets are normally distributed, a parametric t-test can be calculated. Otherwise, a non-parametric test is used.
(d) The detection limits were reviewed to determine whether the data sets have equal or multiple detection limits. Detection Limits were only reviewed if the Site or Background data sets had a FOD less than 100% but greater than 80%.
(e) The hypothesis tests were selected depending on the FOD, distribution, and detection limits. See Figure 1.
(f) If both background and site data are normally distributed and have FOD=100%, 1 standard deviation is used. If either site or background dataset has any nondetects or either dataset is not normal, the 84.13th - 50th percentile is used to approximate 1 SD.
(g) For the nonparametric WMW test, the p value is approximated. For the nonparametric WMW test, the p value is approximated. Therefore, the comparison of the calculated test statistic is compared to the test critical value to determine whether to reject the null hypothesis. If the U-statistic is less than the critical value, the null hypothesis is rejected.
(h) The null hypothesis (Ho) was rejected when the calculated p-value was less than 0.1.
(i) If the Quantile test rejects the null hypothesis and accepts the alternate hypothesis (H_A: Site > Bkg), then the Site data set is not consistent with Background. Otherwise, the results of the WMW or the Gehan tests are used. For either the WMW or the Gehan test, if the null hypothesis is accepted (H_0: Site >= Bkg + S), then the Site data set is not consistent with Background. If the WMW or Gehan test rejects the null hypothesis and accepts the alternate hypothesis (HA: Site < Bkg + S), then the Site data set is consistent with Background.
(j) ProUCL does not give a result for the WMW test if background dataset contains all detected results and the site dataset has NDs; results for Gehan's Test shown.

TABLE I-3
SUMMARY OF RESULTS OF UPDATED BACKGROUND EVALUATIONS (ADDENDUM)
ADDENDUM TO STATISTICAL EVALUATION OF BACKGROUND SOIL
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

Constituent	Site Data Are Consistent with Background (a)?															
	AOC 1		AOC 3		AOC 16 and AOC 21		AOC 19		Block A		AOC 18		AOC 22 (Riparian Area)		Southern Parcel	
	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA	Yes	NC	No	NA
Arsenic	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	Yes	Yes	Yes	NC	Yes	Yes
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	NA	Yes	NC	No	NA
Lead	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	Yes	Yes	Yes	NC	Yes	Yes
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA	No	NC	No	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	NA	Yes	NC	No	NA
BAP-TE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	NA	Yes	NC	Yes	NA

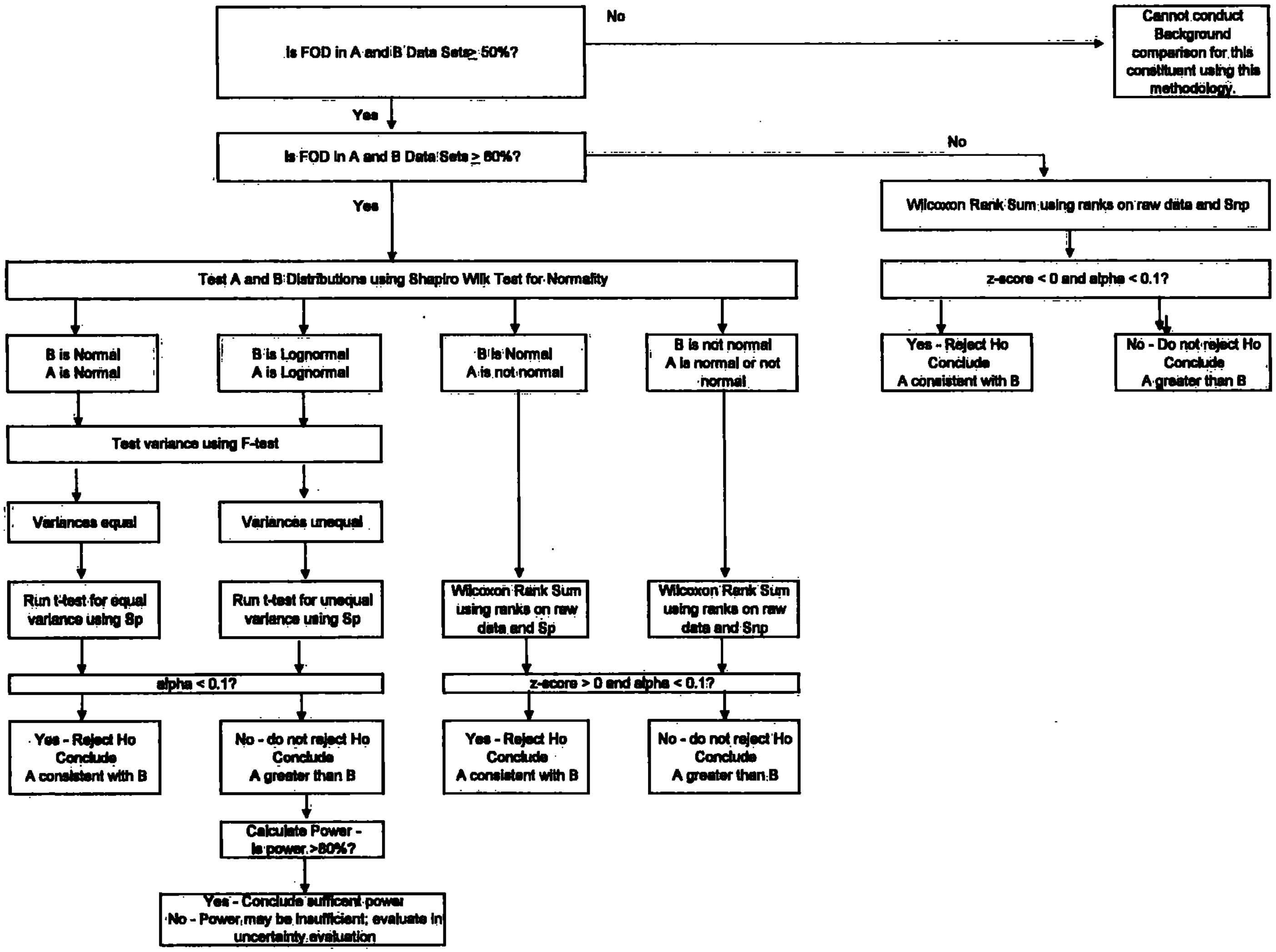
Notes:
BAP-TE - Benzo(a)Pyrene Toxicity Equivalent.
(a) The background evaluation was conducted using ProUCL 4.00.02 (USEPA, 2007) and Stata (Stata Corporation, 2003). For details of statistical analysis, see Table I-2a (surface soil) and Table I-2b (combined soil).
NA - Not applicable. Constituents were not included in the background evaluation in the specified human health exposure area and media.
NC - Not calculated. All soil samples in AOC 22 (Riparian Area) are surface soil.

TABLE I-4
SUMMARY OF RESULTS OF BACKGROUND EVALUATIONS (ORIGINAL AND ADDENDUM)
STATISTICAL EVALUATION OF BACKGROUND SOIL
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

	Site Data Are Consistent with Background?															
	AOC 1 (b)		AOC 2 (b)		AOC 18 and AOC 21 (b)		AOC 19 (b)		Block A (b)		AOC 13 (a)		AOC 22 (Riparian Area) (a)		Southern Parcel (a)	
Constituent	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil
Aluminum	No	NA	No	NA	No	NA	No	NA	No	NA	No	NA	Yes	NC	No	NA
Arsenic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NC	Yes	Yes
Iron	No	NA	Yes	NA	Yes	NA	Yes	NA	No	NA	Yes	NA	Yes	NC	No	NA
Lead	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	Yes	Yes	Yes	NC	Yes	Yes
Manganese	No	NA	No	NA	No	NA	Yes	NA	No	NA	No	NA	No	NC	No	NA
Mercury	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA	NA
Vanadium	No	NA	No	NA	No	NA	No	NA	No	NA	Yes	NA	Yes	NC	No	NA
BAP-TE	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NC	Yes	NA

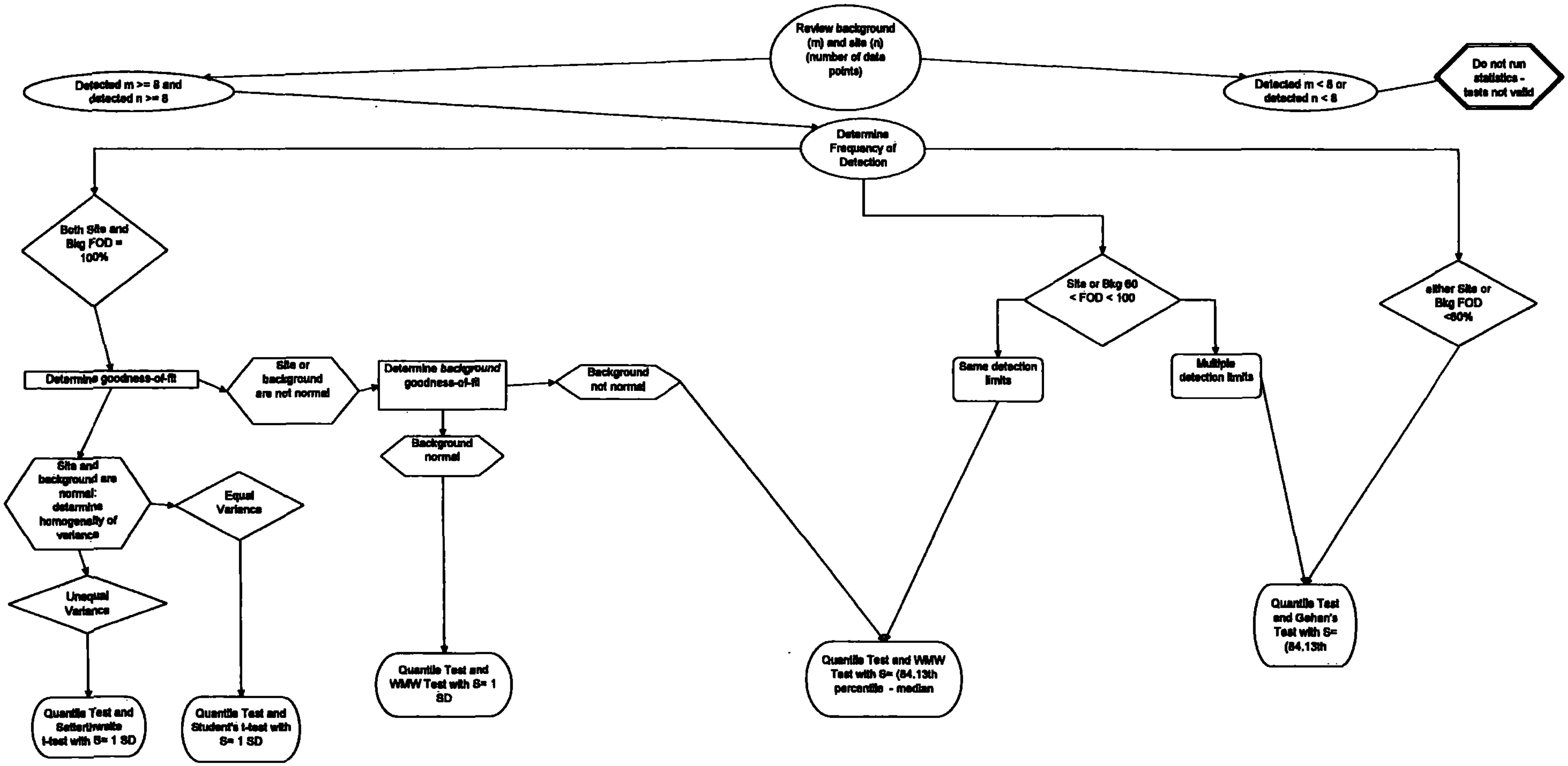
Notes:
BAP-TE - Benzo(a)Pyrene Toxicity Equivalent.
(a) Results from the Addendum to the Background Evaluation of Soil. The background evaluation was conducted using ProUCL 4.00.02 (USEPA, 2007) and Stata (Stata Corporation, 2003). For details of statistical analysis, see Table I-2a (surface soil) and Table I-2b (combined soil).
(b) Results for surface soil are from the original Background Evaluation of Soil. See Tables I-1a through I-1e for results. Results for combined soil are from the Addendum to the Background Evaluation of Soil. The results are provided in Table I-2b. The updated background evaluation was conducted using ProUCL 4.00.02 (USEPA, 2007) and Stata (Stata Corporation, 2003).
NA - Not applicable. Constituents were not included in the background evaluation in the specified human health exposure area and media.
NC - Not calculated. All soil samples in AOC 22 (Riparian Area) are surface soil.

Figure I-1
Background Comparison Approach
Former ARMCO Hamilton Site



Notes:
FOD = Frequency of Detection = Number of Detects/Total number of Samples * 100%.
A = Area of Investigation
B = Background
Sp = Substantial Difference where Background data are at least 80% detected and normally distributed. Equal to the standard deviation of the background data set.
Snp = Substantial Difference where Background data are greater than 50% detected but less than 80% detected, and/or not normally distributed.
Equal to the difference between the 84.13th and 50th percentiles of the background data (equivalent to one standard deviation for a normal distribution).

Figure I-2 - Background Evaluation Hypothesis Test Selection Flow Chart



Notes:
n = Site sample size
m = Background sample size
SD - Standard Deviation.
WMW - Wilcoxon-Mann-Whitney.
FOD = Frequency of Detection.
Quantile Test uses Form 1
All other tests use Form 2

Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects

User Selected Options

From File	J:\Indi_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	0.9

Aluminum (aoc 13)

Raw Statistics

Number of Valid Observations	27
Number of Distinct Observations	25
Minimum	4920
Maximum	36100
Mean of Raw Data	12181
Standard Deviation of Raw Data	6901
Kstar	3.488
Mean of Log Transformed Data	9.274
Standard Deviation of Log Transformed Data	0.519

Normal Distribution Test Results

Correlation Coefficient R	0.914
Shapiro Wilk Test Statistic	0.846
Shapiro Wilk Critical (0.9) Value	0.935
Lilliefors Test Statistic	0.153
Lilliefors Critical (0.9) Value	0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.969
A-D Test Statistic	0.597
A-D Critical (0.9) Value	0.63
K-S Test Statistic	0.142
K-S Critical(0.9) Value	0.155

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.977
Shapiro Wilk Test Statistic	0.948
Shapiro Wilk Critical (0.9) Value	0.935
Lilliefors Test Statistic	0.145
Lilliefors Critical (0.9) Value	0.155

Data appear Lognormal at (0.1) Significance Level

Aluminum (aoc 22)

Raw Statistics

Number of Valid Observations 18
Number of Distinct Observations 18
Minimum 3020
Maximum 19200
Mean of Raw Data 9541
Standard Deviation of Raw Data 4354
Kstar 4.544
Mean of Log Transformed Data 9.068
Standard Deviation of Log Transformed Data 0.454

Normal Distribution Test Results

Correlation Coefficient R 0.947
Shapiro Wilk Test Statistic 0.898
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.174
Lilliefors Critical (0.9) Value 0.19

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.977
A-D Test Statistic 0.48
A-D Critical (0.9) Value 0.626
K-S Test Statistic 0.126
K-S Critical(0.9) Value 0.188

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.973
Shapiro Wilk Test Statistic 0.953
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.135
Lilliefors Critical (0.9) Value 0.19

Data appear Lognormal at (0.1) Significance Level

Aluminum (background)

Raw Statistics

Number of Valid Observations 11
Number of Distinct Observations 11
Minimum 3910
Maximum 17400
Mean of Raw Data 8493
Standard Deviation of Raw Data 4233
Kstar 3.602
Mean of Log Transformed Data 8.941

Standard Deviation of Log Transformed Data 0.48

Normal Distribution Test Results

Correlation Coefficient R 0.946
Shapiro Wilk Test Statistic 0.891
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.218
Lilliefors Critical (0.9) Value 0.243

Data appear Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.981
A-D Test Statistic 0.345
A-D Critical (0.9) Value 0.619
K-S Test Statistic 0.169
K-S Critical(0.9) Value 0.236

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.98
Shapiro Wilk Test Statistic 0.949
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.138
Lilliefors Critical (0.9) Value 0.243

Data appear Lognormal at (0.1) Significance Level

Aluminum (s. exposure area rev)

Raw Statistics

Number of Valid Observations 121
Number of Missing Values 21
Number of Distinct Observations 106
Minimum 4260
Maximum 90200
Mean of Raw Data 19217
Standard Deviation of Raw Data 11216
Kstar 3.278
Mean of Log Transformed Data 9.707
Standard Deviation of Log Transformed Data 0.579

Normal Distribution Test Results

Correlation Coefficient R 0.912
Lilliefors Test Statistic 0.105
Lilliefors Critical (0.9) Value 0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.954
A-D Test Statistic 0.665
A-D Critical (0.9) Value 0.636
K-S Test Statistic 0.0732
K-S Critical(0.9) Value 0.0776

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.984
Lilliefors Test Statistic 0.0837
Lilliefors Critical (0.9) Value 0.0732

Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 13)

Raw Statistics

Number of Valid Observations 27
Number of Distinct Observations 26
Minimum 0.178
Maximum 14.8
Mean of Raw Data 7.238
Standard Deviation of Raw Data 2.975
Kstar 2.973
Mean of Log Transformed Data 1.821
Standard Deviation of Log Transformed Data 0.788

Normal Distribution Test Results

Correlation Coefficient R 0.978
Shapiro Wilk Test Statistic 0.971
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.127
Lilliefors Critical (0.9) Value 0.155

Data appear Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.972
A-D Test Statistic 1.334
A-D Critical (0.9) Value 0.631
K-S Test Statistic 0.217
K-S Critical(0.9) Value 0.155

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.762
Shapiro Wilk Test Statistic 0.616
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.288
Lilliefors Critical (0.9) Value 0.155

Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 22)

Raw Statistics

Number of Valid Observations 18
Number of Distinct Observations 18
Minimum 3.26
Maximum 14.3
Mean of Raw Data 8.049
Standard Deviation of Raw Data 3.454
Kstar 4.889
Mean of Log Transformed Data 1.997
Standard Deviation of Log Transformed Data 0.436

Normal Distribution Test Results

Correlation Coefficient R 0.958
Shapiro Wilk Test Statistic 0.905
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.234
Lilliefors Critical (0.9) Value 0.19

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.967
A-D Test Statistic 0.577
A-D Critical (0.9) Value 0.626
K-S Test Statistic 0.201
K-S Critical(0.9) Value 0.187

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.977
Shapiro Wilk Test Statistic 0.943
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.176
Lilliefors Critical (0.9) Value 0.19

Data appear Lognormal at (0.1) Significance Level

Arsenic (background)

Raw Statistics

Number of Valid Observations 11
Number of Distinct Observations 11
Minimum 5.9
Maximum 68.5
Mean of Raw Data 19.78
Standard Deviation of Raw Data 19.63
Kstar 1.238
Mean of Log Transformed Data 2.645
Standard Deviation of Log Transformed Data 0.808

Normal Distribution Test Results

Correlation Coefficient R 0.849
Shapiro Wilk Test Statistic 0.729
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.327
Lilliefors Critical (0.9) Value 0.243

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.968
A-D Test Statistic 0.796
A-D Critical (0.9) Value 0.627
K-S Test Statistic 0.26
K-S Critical(0.9) Value 0.238

Data follow Appr. Gamma Distribution at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.949
Shapiro Wilk Test Statistic 0.891
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.203
Lilliefors Critical (0.9) Value 0.243

Data appear Lognormal at (0.1) Significance Level

Arsenic (s. exposure area rev)

Raw Statistics

Number of Valid Observations 121
Number of Missing Values 21
Number of Distinct Observations 86
Minimum 0.474
Maximum 33.6
Mean of Raw Data 8.779
Standard Deviation of Raw Data 6.17

Kstar 1.931

Mean of Log Transformed Data 1.898

Standard Deviation of Log Transformed Data 0.831

Normal Distribution Test Results

Correlation Coefficient R 0.924

Lilliefors Test Statistic 0.156

Lilliefors Critical (0.9) Value 0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.977

A-D Test Statistic 2.075

A-D Critical (0.9) Value 0.642

K-S Test Statistic 0.104

K-S Critical(0.9) Value 0.0781

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.957

Lilliefors Test Statistic 0.146

Lilliefors Critical (0.9) Value 0.0732

Data not Lognormal at (0.1) Significance Level

Iron (soc 13)

Raw Statistics

Number of Valid Observations 27

Number of Distinct Observations 25

Minimum 2200

Maximum 185000

Mean of Raw Data 22602

Standard Deviation of Raw Data 33010

Kstar 1.544

Mean of Log Transformed Data 9.706

Standard Deviation of Log Transformed Data 0.685

Normal Distribution Test Results

Correlation Coefficient R 0.563

Shapiro Wilk Test Statistic 0.353

Shapiro Wilk Critical (0.9) Value 0.935

Lilliefors Test Statistic 0.381

Lilliefors Critical (0.9) Value 0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.721
A-D Test Statistic 3.156
A-D Critical (0.9) Value 0.639
K-S Test Statistic 0.248
K-S Critical(0.9) Value 0.157

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.857
Shapiro Wilk Test Statistic 0.783
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.216
Lilliefors Critical (0.9) Value 0.155

Data not Lognormal at (0.1) Significance Level

Iron (aoc 22)

Raw Statistics

Number of Valid Observations 18
Number of Distinct Observations 18
Minimum 8940
Maximum 69200
Mean of Raw Data 31036
Standard Deviation of Raw Data 19544
Kstar 2.28
Mean of Log Transformed Data 10.15
Standard Deviation of Log Transformed Data 0.657

Normal Distribution Test Results

Correlation Coefficient R 0.953
Shapiro Wilk Test Statistic 0.892
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.216
Lilliefors Critical (0.9) Value 0.19

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.976
A-D Test Statistic 0.505
A-D Critical (0.9) Value 0.631
K-S Test Statistic 0.18
K-S Critical(0.9) Value 0.189

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.979
Shapiro Wilk Test Statistic 0.94
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.147
Lilliefors Critical (0.9) Value 0.19

Data appear Lognormal at (0.1) Significance Level

Iron (background)

Raw Statistics

Number of Valid Observations 11
Number of Distinct Observations 11
Minimum 13600
Maximum 132000
Mean of Raw Data 28309
Standard Deviation of Raw Data 34564
Kstar 1.42
Mean of Log Transformed Data 9.96
Standard Deviation of Log Transformed Data 0.635

Normal Distribution Test Results

Correlation Coefficient R 0.635
Shapiro Wilk Test Statistic 0.436
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.444
Lilliefors Critical (0.9) Value 0.243

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.799
A-D Test Statistic 2.211
A-D Critical (0.9) Value 0.626
K-S Test Statistic 0.37
K-S Critical(0.9) Value 0.238

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.77
Shapiro Wilk Test Statistic 0.622
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.3
Lilliefors Critical (0.9) Value 0.243

Data not Lognormal at (0.1) Significance Level

Iron (s. exposure area rev)

Raw Statistics

Number of Valid Observations	121
Number of Missing Values	21
Number of Distinct Observations	110
Minimum	4805
Maximum	170000
Mean of Raw Data	45797
Standard Deviation of Raw Data	39323
Kstar	1.542
Mean of Log Transformed Data	10.38
Standard Deviation of Log Transformed Data	0.852

Normal Distribution Test Results

Correlation Coefficient R	0.914
Lilliefors Test Statistic	0.204
Lilliefors Critical (0.9) Value	0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.985
A-D Test Statistic	2.368
A-D Critical (0.9) Value	0.645
K-S Test Statistic	0.143
K-S Critical(0.9) Value	0.0784

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.988
Lilliefors Test Statistic	0.1
Lilliefors Critical (0.9) Value	0.0732

Data not Lognormal at (0.1) Significance Level

Lead (aoc 13)

Raw Statistics

Number of Valid Observations	27
Number of Distinct Observations	26
Minimum	1.53
Maximum	464
Mean of Raw Data	53.95
Standard Deviation of Raw Data	105.3
Kstar	0.694
Mean of Log Transformed Data	3.193
Standard Deviation of Log Transformed Data	1.11

Normal Distribution Test Results

Correlation Coefficient R 0.654
Shapiro Wilk Test Statistic 0.449
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.393
Lilliefors Critical (0.9) Value 0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.886
A-D Test Statistic 3.1
A-D Critical (0.9) Value 0.656
K-S Test Statistic 0.295
K-S Critical(0.9) Value 0.16

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.923
Shapiro Wilk Test Statistic 0.874
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.186
Lilliefors Critical (0.9) Value 0.155

Data not Lognormal at (0.1) Significance Level

Lead (aoc 22)

Raw Statistics

Number of Valid Observations 17
Number of Missing Values 1
Number of Distinct Observations 17
Minimum 10.2
Maximum 341
Mean of Raw Data 107.1
Standard Deviation of Raw Data 109.4
Kstar 1.026
Mean of Log Transformed Data 4.202
Standard Deviation of Log Transformed Data 1.019

Normal Distribution Test Results

Correlation Coefficient R 0.881
Shapiro Wilk Test Statistic 0.769
Shapiro Wilk Critical (0.9) Value 0.91
Lilliefors Test Statistic 0.279
Lilliefors Critical (0.9) Value 0.195

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.959
A-D Test Statistic 0.559
A-D Critical (0.9) Value 0.641
K-S Test Statistic 0.169
K-S Critical(0.9) Value 0.197

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.984
Shapiro Wilk Test Statistic 0.96
Shapiro Wilk Critical (0.9) Value 0.91
Lilliefors Test Statistic 0.111
Lilliefors Critical (0.9) Value 0.195

Data appear Lognormal at (0.1) Significance Level

Lead (background)

Raw Statistics

Number of Valid Observations 11
Number of Distinct Observations 11
Minimum 13.25
Maximum 2230
Mean of Raw Data 257.3
Standard Deviation of Raw Data 657.2
Kstar 0.375
Mean of Log Transformed Data 4.047
Standard Deviation of Log Transformed Data 1.499

Normal Distribution Test Results

Correlation Coefficient R 0.62
Shapiro Wilk Test Statistic 0.415
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.427
Lilliefors Critical (0.9) Value 0.243

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.899
A-D Test Statistic 1.535
A-D Critical (0.9) Value 0.664
K-S Test Statistic 0.334
K-S Critical(0.9) Value 0.248

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.921
Shapiro Wilk Test Statistic 0.857
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.19
Lilliefors Critical (0.9) Value 0.243

Data not Lognormal at (0.1) Significance Level

Lead (s. exposure area rev)

Raw Statistics

Number of Valid Observations 121
Number of Missing Values 21
Number of Distinct Observations 114
Minimum 1.86
Maximum 1330
Mean of Raw Data 75.92
Standard Deviation of Raw Data 143.4
Kstar 0.732
Mean of Log Transformed Data 3.525
Standard Deviation of Log Transformed Data 1.23

Normal Distribution Test Results

Correlation Coefficient R 0.663
Lilliefors Test Statistic 0.303
Lilliefors Critical (0.9) Value 0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.883
A-D Test Statistic 4.056
A-D Critical (0.9) Value 0.664
K-S Test Statistic 0.16
K-S Critical(0.9) Value 0.08

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.992
Lilliefors Test Statistic 0.101
Lilliefors Critical (0.9) Value 0.0732

Data not Lognormal at (0.1) Significance Level

Manganese (soc 13)

Raw Statistics

Number of Valid Observations	27
Number of Distinct Observations	27
Minimum	318
Maximum	4200
Mean of Raw Data	991.6
Standard Deviation of Raw Data	871.5
Kstar	1.821
Mean of Log Transformed Data	6.632
Standard Deviation of Log Transformed Data	0.703

Normal Distribution Test Results

Correlation Coefficient R	0.849
Shapiro Wilk Test Statistic	0.734
Shapiro Wilk Critical (0.9) Value	0.935
Lilliefors Test Statistic	0.258
Lilliefors Critical (0.9) Value	0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.959
A-D Test Statistic	1.165
A-D Critical (0.9) Value	0.636
K-S Test Statistic	0.179
K-S Critical(0.9) Value	0.156

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.962
Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical (0.9) Value	0.935
Lilliefors Test Statistic	0.133
Lilliefors Critical (0.9) Value	0.155

Data not Lognormal at (0.1) Significance Level

Manganese (aoc 22)

Raw Statistics

Number of Valid Observations	18
Number of Distinct Observations	18
Minimum	236
Maximum	3180
Mean of Raw Data	1118
Standard Deviation of Raw Data	908.1
Kstar	1.719

Mean of Log Transformed Data 6.751
Standard Deviation of Log Transformed Data 0.737

Normal Distribution Test Results

Correlation Coefficient R 0.894
Shapiro Wilk Test Statistic 0.794
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.233
Lilliefors Critical (0.9) Value 0.19

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.967
A-D Test Statistic 0.611
A-D Critical (0.9) Value 0.634
K-S Test Statistic 0.137
K-S Critical(0.9) Value 0.189

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.982
Shapiro Wilk Test Statistic 0.956
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.0972
Lilliefors Critical (0.9) Value 0.19

Data appear Lognormal at (0.1) Significance Level

Manganese (background)

Raw Statistics

Number of Valid Observations 11
Number of Distinct Observations 11
Minimum 278
Maximum 2270
Mean of Raw Data 833.2
Standard Deviation of Raw Data 519.6
Kstar 2.904
Mean of Log Transformed Data 6.592
Standard Deviation of Log Transformed Data 0.523

Normal Distribution Test Results

Correlation Coefficient R 0.834
Shapiro Wilk Test Statistic 0.728
Shapiro Wilk Critical (0.9) Value 0.876
Lilliefors Test Statistic 0.335

Lilliefors Critical (0.9) Value 0.243

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.9

A-D Test Statistic 0.607

A-D Critical (0.9) Value 0.62

K-S Test Statistic 0.258

K-S Critical(0.9) Value 0.236

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.946

Shapiro Wilk Test Statistic 0.924

Shapiro Wilk Critical (0.9) Value 0.876

Lilliefors Test Statistic 0.23

Lilliefors Critical (0.9) Value 0.243

Data appear Lognormal at (0.1) Significance Level

Manganese (s. exposure area rev)

Raw Statistics

Number of Valid Observations 121

Number of Missing Values 21

Number of Distinct Observations 116

Minimum 337

Maximum 20700

Mean of Raw Data 3031

Standard Deviation of Raw Data 2976

Kstar 1.431

Mean of Log Transformed Data 7.637

Standard Deviation of Log Transformed Data 0.905

Normal Distribution Test Results

Correlation Coefficient R 0.832

Lilliefors Test Statistic 0.183

Lilliefors Critical (0.9) Value 0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.936

A-D Test Statistic 1.375

A-D Critical (0.9) Value 0.646

K-S Test Statistic 0.091

K-S Critical(0.9) Value 0.0785

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.983
Lilliefors Test Statistic 0.105
Lilliefors Critical (0.9) Value 0.0732

Data not Lognormal at (0.1) Significance Level

Vanadium (aoc 13)

Raw Statistics

Number of Valid Observations 27
Number of Distinct Observations 27
Minimum 5.24
Maximum 45
Mean of Raw Data 22.36
Standard Deviation of Raw Data 10.25
Kstar 4.394
Mean of Log Transformed Data 3.002
Standard Deviation of Log Transformed Data 0.484

Normal Distribution Test Results

Correlation Coefficient R 0.964
Shapiro Wilk Test Statistic 0.925
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.18
Lilliefors Critical (0.9) Value 0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.984
A-D Test Statistic 0.428
A-D Critical (0.9) Value 0.629
K-S Test Statistic 0.136
K-S Critical(0.9) Value 0.155

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.975
Shapiro Wilk Test Statistic 0.955
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.124
Lilliefors Critical (0.9) Value 0.155

Data appear Lognormal at (0.1) Significance Level

Vanadium (aoc 22)

Raw Statistics

Number of Valid Observations	18
Number of Distinct Observations	18
Minimum	7.55
Maximum	30.5
Mean of Raw Data	16.68
Standard Deviation of Raw Data	6.958
Kstar	5.212
Mean of Log Transformed Data	2.732
Standard Deviation of Log Transformed Data	0.422

Normal Distribution Test Results

Correlation Coefficient R	0.972
Shapiro Wilk Test Statistic	0.933
Shapiro Wilk Critical (0.9) Value	0.914
Lilliefors Test Statistic	0.167
Lilliefors Critical (0.9) Value	0.19

Data appear Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.987
A-D Test Statistic	0.267
A-D Critical (0.9) Value	0.626
K-S Test Statistic	0.117
K-S Critical(0.9) Value	0.187

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.988
Shapiro Wilk Test Statistic	0.964
Shapiro Wilk Critical (0.9) Value	0.914
Lilliefors Test Statistic	0.1
Lilliefors Critical (0.9) Value	0.19

Data appear Lognormal at (0.1) Significance Level

Vanadium (background)

Raw Statistics

Number of Valid Observations	11
Number of Distinct Observations	11
Minimum	10.7
Maximum	35
Mean of Raw Data	21.54
Standard Deviation of Raw Data	8.431

Kstar 4.932

Mean of Log Transformed Data 2.993

Standard Deviation of Log Transformed Data 0.421

Normal Distribution Test Results

Correlation Coefficient R 0.979

Shapiro Wilk Test Statistic 0.938

Shapiro Wilk Critical (0.9) Value 0.876

Lilliefors Test Statistic 0.139

Lilliefors Critical (0.9) Value 0.243

Data appear Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.974

A-D Test Statistic 0.336

A-D Critical (0.9) Value 0.619

K-S Test Statistic 0.16

K-S Critical(0.9) Value 0.235

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.972

Shapiro Wilk Test Statistic 0.923

Shapiro Wilk Critical (0.9) Value 0.876

Lilliefors Test Statistic 0.151

Lilliefors Critical (0.9) Value 0.243

Data appear Lognormal at (0.1) Significance Level

Vanadium (s. exposure area rev)

Raw Statistics

Number of Valid Observations 121

Number of Missing Values 21

Number of Distinct Observations 107

Minimum 8.4

Maximum 485

Mean of Raw Data 33.23

Standard Deviation of Raw Data 45.32

Kstar 2.264

Mean of Log Transformed Data 3.272

Standard Deviation of Log Transformed Data 0.565

Normal Distribution Test Results

Correlation Coefficient R 0.547

Lilliefors Test Statistic 0.3

Lilliefors Critical (0.9) Value 0.0732

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.68

A-D Test Statistic 5.069

A-D Critical (0.9) Value 0.641

K-S Test Statistic 0.142

K-S Critical(0.9) Value 0.078

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.956

Lilliefors Test Statistic 0.0734

Lilliefors Critical (0.9) Value 0.0732

Data not Lognormal at (0.1) Significance Level

BAP-TE (soc 13)

Raw Statistics

Number of Valid Observations 27

Number of Distinct Observations 27

Minimum 0.251

Maximum 59.68

Mean of Raw Data 6.521

Standard Deviation of Raw Data 13.59

Kstar 0.406

Mean of Log Transformed Data 0.36

Standard Deviation of Log Transformed Data 1.641

Normal Distribution Test Results

Correlation Coefficient R 0.716

Shapiro Wilk Test Statistic 0.532

Shapiro Wilk Critical (0.9) Value 0.935

Lilliefors Test Statistic 0.359

Lilliefors Critical (0.9) Value 0.155

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.974

A-D Test Statistic 2.773

A-D Critical (0.9) Value 0.685

K-S Test Statistic 0.292

K-S Critical(0.9) Value 0.164

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.932
Shapiro Wilk Test Statistic 0.856
Shapiro Wilk Critical (0.9) Value 0.935
Lilliefors Test Statistic 0.203
Lilliefors Critical (0.9) Value 0.155
Data not Lognormal at (0.1) Significance Level

BAP-TE (aoc 22)

Raw Statistics
Number of Valid Observations 18
Number of Distinct Observations 18
Minimum 0.453
Maximum 52.79
Mean of Raw Data 8.775
Standard Deviation of Raw Data 17.07
Kstar 0.405
Mean of Log Transformed Data 0.705
Standard Deviation of Log Transformed Data 1.58

Normal Distribution Test Results

Correlation Coefficient R 0.728
Shapiro Wilk Test Statistic 0.535
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.418
Lilliefors Critical (0.9) Value 0.19
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.928
A-D Test Statistic 2.487
A-D Critical (0.9) Value 0.676
K-S Test Statistic 0.332
K-S Critical(0.9) Value 0.198
Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.902
Shapiro Wilk Test Statistic 0.802
Shapiro Wilk Critical (0.9) Value 0.914
Lilliefors Test Statistic 0.225
Lilliefors Critical (0.9) Value 0.19
Data not Lognormal at (0.1) Significance Level

BAP-TE (background)

Raw Statistics

Number of Valid Observations	10
Number of Missing Values	1
Number of Distinct Observations	10
Minimum	0.238
Maximum	10.43
Mean of Raw Data	2.293
Standard Deviation of Raw Data	3.127
Kstar	0.677
Mean of Log Transformed Data	0.157
Standard Deviation of Log Transformed Data	1.204

Normal Distribution Test Results

Correlation Coefficient R	0.813
Shapiro Wilk Test Statistic	0.68
Shapiro Wilk Critical (0.9) Value	0.869
Lilliefors Test Statistic	0.316
Lilliefors Critical (0.9) Value	0.255

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.968
A-D Test Statistic	0.469
A-D Critical (0.9) Value	0.635
K-S Test Statistic	0.227
K-S Critical(0.9) Value	0.252

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.983
Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical (0.9) Value	0.869
Lilliefors Test Statistic	0.147
Lilliefors Critical (0.9) Value	0.255

Data appear Lognormal at (0.1) Significance Level

BAP-TE (s. exposure area rev)

Raw Statistics

Number of Valid Observations	119
Number of Missing Values	23
Number of Distinct Observations	116
Minimum	0.182

Maximum 90.13

Mean of Raw Data 3.655

Standard Deviation of Raw Data 9.536

Kstar 0.611

Mean of Log Transformed Data 0.307

Standard Deviation of Log Transformed Data 1.218

Normal Distribution Test Results

Correlation Coefficient R 0.563

Lilliefors Test Statistic 0.358

Lilliefors Critical (0.9) Value 0.0738

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.83

A-D Test Statistic 8.647

A-D Critical (0.9) Value 0.672

K-S Test Statistic 0.199

K-S Critical(0.9) Value 0.0811

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.96

Lilliefors Test Statistic 0.128

Lilliefors Critical (0.9) Value 0.0738

Data not Lognormal at (0.1) Significance Level

Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	0.9

Aluminum (aoc 13)

Raw Statistics

Number of Valid Observations	79
Number of Distinct Observations	75
Minimum	2100
Maximum	50800
Mean of Raw Data	12861
Standard Deviation of Raw Data	9812
Kstar	1.88
Mean of Log Transformed Data	9.183
Standard Deviation of Log Transformed Data	0.776

Normal Distribution Test Results

Correlation Coefficient R	0.925
Lilliefors Test Statistic	0.136
Lilliefors Critical (0.9) Value	0.0906

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.992
A-D Test Statistic	0.639
A-D Critical (0.9) Value	0.642
K-S Test Statistic	0.0721
K-S Critical(0.9) Value	0.0934

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.987
Lilliefors Test Statistic	0.121
Lilliefors Critical (0.9) Value	0.0906

Data not Lognormal at (0.1) Significance Level

Aluminum (background)

Raw Statistics

Number of Valid Observations	20
Number of Distinct Observations	19
Minimum	3910

Maximum 31600

Mean of Raw Data 10359

Standard Deviation of Raw Data 6675

Kstar 2.681

Mean of Log Transformed Data 9.077

Standard Deviation of Log Transformed Data 0.588

Normal Distribution Test Results

Correlation Coefficient R 0.903

Shapiro Wilk Test Statistic 0.825

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.167

Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.966

A-D Test Statistic 0.507

A-D Critical (0.9) Value 0.63

K-S Test Statistic 0.138

K-S Critical(0.9) Value 0.179

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.974

Shapiro Wilk Test Statistic 0.94

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.159

Lilliefors Critical (0.9) Value 0.18

Data appear Lognormal at (0.1) Significance Level

Aluminum (s. exposure area rev)

Raw Statistics

Number of Valid Observations 240

Number of Missing Values 48

Number of Distinct Observations 198

Minimum 2030

Maximum 249000

Mean of Raw Data 17575

Standard Deviation of Raw Data 18584

Kstar 2.002

Mean of Log Transformed Data 9.507

Standard Deviation of Log Transformed Data 0.731

Normal Distribution Test Results

Correlation Coefficient R 0.687
Lilliefors Test Statistic 0.204
Lilliefors Critical (0.9) Value 0.052
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.79
A-D Test Statistic 0.95
A-D Critical (0.9) Value 0.641
K-S Test Statistic 0.0471
K-S Critical(0.9) Value 0.0549
Data follow Appr. Gamma Distribution at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.986
Lilliefors Test Statistic 0.0726
Lilliefors Critical (0.9) Value 0.052
Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 13)

Raw Statistics
Number of Valid Observations 79
Number of Distinct Observations 63
Minimum 0.178
Maximum 38.7
Mean of Raw Data 7.567
Standard Deviation of Raw Data 5.518
Kstar 2.208
Mean of Log Transformed Data 1.789
Standard Deviation of Log Transformed Data 0.773

Normal Distribution Test Results

Correlation Coefficient R 0.874
Lilliefors Test Statistic 0.162
Lilliefors Critical (0.9) Value 0.0906
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.956
A-D Test Statistic 0.685
A-D Critical (0.9) Value 0.64
K-S Test Statistic 0.079
K-S Critical(0.9) Value 0.0932

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.936
Lilliefors Test Statistic 0.0984
Lilliefors Critical (0.9) Value 0.0906

Data not Lognormal at (0.1) Significance Level

Arsenic (background)

Raw Statistics

Number of Valid Observations	20
Number of Distinct Observations	19
Minimum	5.3
Maximum	68.5
Mean of Raw Data	16.16
Standard Deviation of Raw Data	15.99
Kstar	1.587
Mean of Log Transformed Data	2.485
Standard Deviation of Log Transformed Data	0.713

Normal Distribution Test Results

Correlation Coefficient R	0.806
Shapiro Wilk Test Statistic	0.663
Shapiro Wilk Critical (0.9) Value	0.92
Lilliefors Test Statistic	0.334
Lilliefors Critical (0.9) Value	0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.939
A-D Test Statistic	1.685
A-D Critical (0.9) Value	0.635
K-S Test Statistic	0.247
K-S Critical(0.9) Value	0.181

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.93
Shapiro Wilk Test Statistic	0.862
Shapiro Wilk Critical (0.9) Value	0.92
Lilliefors Test Statistic	0.204
Lilliefors Critical (0.9) Value	0.18

Data not Lognormal at (0.1) Significance Level

Arsenic (s. exposure area rev)

Raw Statistics

Number of Valid Observations 240
Number of Missing Values 48
Number of Distinct Observations 133
Minimum 0.474
Maximum 50.95
Mean of Raw Data 8.631
Standard Deviation of Raw Data 6.802
Kstar 1.925
Mean of Log Transformed Data 1.877
Standard Deviation of Log Transformed Data 0.806

Normal Distribution Test Results

Correlation Coefficient R 0.877
Lilliefors Test Statistic 0.174
Lilliefors Critical (0.9) Value 0.052

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.96
A-D Test Statistic 2.5
A-D Critical (0.9) Value 0.642
K-S Test Statistic 0.0982
K-S Critical(0.9) Value 0.0549

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.974
Lilliefors Test Statistic 0.11
Lilliefors Critical (0.9) Value 0.052

Data not Lognormal at (0.1) Significance Level

Iron (aoc 13)

Raw Statistics

Number of Valid Observations 79
Number of Distinct Observations 73
Minimum 1150
Maximum 190000
Mean of Raw Data 23021
Standard Deviation of Raw Data 32238
Kstar 1.279
Mean of Log Transformed Data 9.62
Standard Deviation of Log Transformed Data 0.844

Normal Distribution Test Results

Correlation Coefficient R 0.693
Lilliefors Test Statistic 0.299
Lilliefors Critical (0.9) Value 0.0906

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.867
A-D Test Statistic 3.585
A-D Critical (0.9) Value 0.649
K-S Test Statistic 0.184
K-S Critical(0.9) Value 0.0941

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.973
Lilliefors Test Statistic 0.107
Lilliefors Critical (0.9) Value 0.0906

Data not Lognormal at (0.1) Significance Level

Iron (background)

Raw Statistics

Number of Valid Observations 20
Number of Distinct Observations 20
Minimum 10500
Maximum 132000
Mean of Raw Data 25775
Standard Deviation of Raw Data 25715
Kstar 2.403
Mean of Log Transformed Data 9.967
Standard Deviation of Log Transformed Data 0.515

Normal Distribution Test Results

Correlation Coefficient R 0.638
Shapiro Wilk Test Statistic 0.439
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.342
Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.768

A-D Test Statistic 2.323
A-D Critical (0.9) Value 0.631
K-S Test Statistic 0.277
K-S Critical(0.9) Value 0.179
Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.861
Shapiro Wilk Test Statistic 0.77
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.233
Lilliefors Critical (0.9) Value 0.18
Data not Lognormal at (0.1) Significance Level

Iron (s. exposure area rev)

Raw Statistics
Number of Valid Observations 240
Number of Missing Values 48
Number of Distinct Observations 208
Minimum 4250
Maximum 397000
Mean of Raw Data 39196
Standard Deviation of Raw Data 44899
Kstar 1.315
Mean of Log Transformed Data 10.15
Standard Deviation of Log Transformed Data 0.888

Normal Distribution Test Results

Correlation Coefficient R 0.808
Lilliefors Test Statistic 0.239
Lilliefors Critical (0.9) Value 0.052
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.957
A-D Test Statistic 5.643
A-D Critical (0.9) Value 0.649
K-S Test Statistic 0.135
K-S Critical(0.9) Value 0.0553
Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.992
Lilliefors Test Statistic 0.074

Lilliefors Critical (0.9) Value 0.052

Data not Lognormal at (0.1) Significance Level

Lead (aoc 13)

Raw Statistics

Number of Valid Observations 79

Number of Distinct Observations 64

Minimum 0.254

Maximum 464

Mean of Raw Data 41.63

Standard Deviation of Raw Data 81.85

Kstar 0.653

Mean of Log Transformed Data 2.821

Standard Deviation of Log Transformed Data 1.265

Normal Distribution Test Results

Correlation Coefficient R 0.679

Lilliefors Test Statistic 0.342

Lilliefors Critical (0.9) Value 0.0906

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.92

A-D Test Statistic 5.099

A-D Critical (0.9) Value 0.668

K-S Test Statistic 0.203

K-S Critical(0.9) Value 0.096

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.969

Lilliefors Test Statistic 0.135

Lilliefors Critical (0.9) Value 0.0906

Data not Lognormal at (0.1) Significance Level

Lead (background)

Raw Statistics

Number of Valid Observations 20

Number of Distinct Observations 20

Minimum 9.7

Maximum 2230

Mean of Raw Data 163.4

Standard Deviation of Raw Data 492

Kstar 0.409

Mean of Log Transformed Data 3.629
Standard Deviation of Log Transformed Data 1.375

Normal Distribution Test Results

Correlation Coefficient R 0.55
Shapiro Wilk Test Statistic 0.331
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.406
Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.846
A-D Test Statistic 2.801
A-D Critical (0.9) Value 0.678
K-S Test Statistic 0.279
K-S Critical(0.9) Value 0.189

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.908
Shapiro Wilk Test Statistic 0.83
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.18
Lilliefors Critical (0.9) Value 0.18

Data not Lognormal at (0.1) Significance Level

Lead (s. exposure area rev)

Raw Statistics

Number of Valid Observations 240
Number of Missing Values 48
Number of Distinct Observations 204
Minimum 1.86
Maximum 1330
Mean of Raw Data 53.6
Standard Deviation of Raw Data 109.6
Kstar 0.732
Mean of Log Transformed Data 3.169
Standard Deviation of Log Transformed Data 1.194

Normal Distribution Test Results

Correlation Coefficient R 0.633
Lilliefors Test Statistic 0.318
Lilliefors Critical (0.9) Value 0.052

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.864
A-D Test Statistic 10.57
A-D Critical (0.9) Value 0.665
K-S Test Statistic 0.189
K-S Critical(0.9) Value 0.0563

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.988
Lilliefors Test Statistic 0.101
Lilliefors Critical (0.9) Value 0.052

Data not Lognormal at (0.1) Significance Level

Manganese (aoc 13)

Raw Statistics

Number of Valid Observations 79
Number of Distinct Observations 77
Minimum 234
Maximum 7950
Mean of Raw Data 1078
Standard Deviation of Raw Data 1212
Kstar 1.394
Mean of Log Transformed Data 6.598
Standard Deviation of Log Transformed Data 0.817

Normal Distribution Test Results

Correlation Coefficient R 0.801
Lilliefors Test Statistic 0.276
Lilliefors Critical (0.9) Value 0.0906

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.951
A-D Test Statistic 3.757
A-D Critical (0.9) Value 0.647
K-S Test Statistic 0.193
K-S Critical(0.9) Value 0.0939

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.963
Lilliefors Test Statistic 0.124
Lilliefors Critical (0.9) Value 0.0906
Data not Lognormal at (0.1) Significance Level

Manganese (background)

Raw Statistics
Number of Valid Observations 20
Number of Distinct Observations 19
Minimum 278
Maximum 2270
Mean of Raw Data 761.8
Standard Deviation of Raw Data 406.1
Kstar 4.582
Mean of Log Transformed Data 6.539
Standard Deviation of Log Transformed Data 0.43

Normal Distribution Test Results

Correlation Coefficient R 0.826
Shapiro Wilk Test Statistic 0.711
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.239
Lilliefors Critical (0.9) Value 0.18
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.884
A-D Test Statistic 0.674
A-D Critical (0.9) Value 0.627
K-S Test Statistic 0.168
K-S Critical(0.9) Value 0.179
Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.954
Shapiro Wilk Test Statistic 0.933
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.147
Lilliefors Critical (0.9) Value 0.18
Data appear Lognormal at (0.1) Significance Level

Manganese (s. exposure area rev)

Raw Statistics
Number of Valid Observations 240

Number of Missing Values 48
Number of Distinct Observations 221
Minimum 84
Maximum 20700
Mean of Raw Data 2262
Standard Deviation of Raw Data 2558
Kstar 1.137
Mean of Log Transformed Data 7.229
Standard Deviation of Log Transformed Data 1.015

Normal Distribution Test Results

Correlation Coefficient R 0.829
Lilliefors Test Statistic 0.204
Lilliefors Critical (0.9) Value 0.052

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.958
A-D Test Statistic 3.954
A-D Critical (0.9) Value 0.652
K-S Test Statistic 0.125
K-S Critical(0.9) Value 0.0555

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.99
Lilliefors Test Statistic 0.0762
Lilliefors Critical (0.9) Value 0.052

Data not Lognormal at (0.1) Significance Level

Vanadium (aoc 13)

Raw Statistics

Number of Valid Observations 79
Number of Distinct Observations 71
Minimum 1.57
Maximum 59.5
Mean of Raw Data 21.02
Standard Deviation of Raw Data 12.18
Kstar 2.995
Mean of Log Transformed Data 2.876
Standard Deviation of Log Transformed Data 0.616

Normal Distribution Test Results

Correlation Coefficient R 0.957

Lilliefors Test Statistic 0.161
Lilliefors Critical (0.9) Value 0.0906
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.995
A-D Test Statistic 0.505
A-D Critical (0.9) Value 0.636
K-S Test Statistic 0.0917
K-S Critical(0.9) Value 0.0928
Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.98
Lilliefors Test Statistic 0.0531
Lilliefors Critical (0.9) Value 0.0906
Data appear Lognormal at (0.1) Significance Level

Vanadium (background)

Raw Statistics
Number of Valid Observations 20
Number of Distinct Observations 19
Minimum 10.7
Maximum 59.3
Mean of Raw Data 24.76
Standard Deviation of Raw Data 12.2
Kstar 3.922
Mean of Log Transformed Data 3.096
Standard Deviation of Log Transformed Data 0.493

Normal Distribution Test Results

Correlation Coefficient R 0.943
Shapiro Wilk Test Statistic 0.893
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.125
Lilliefors Critical (0.9) Value 0.18
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.972
A-D Test Statistic 0.531
A-D Critical (0.9) Value 0.628
K-S Test Statistic 0.142
K-S Critical(0.9) Value 0.179

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.969
Shapiro Wilk Test Statistic 0.929
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.149
Lilliefors Critical (0.9) Value 0.18

Data appear Lognormal at (0.1) Significance Level

Vanadium (s. exposure area rev)

Raw Statistics

Number of Valid Observations 240
Number of Missing Values 48
Number of Distinct Observations 189
Minimum 5.2
Maximum 485
Mean of Raw Data 27.88
Standard Deviation of Raw Data 34.15
Kstar 2.416
Mean of Log Transformed Data 3.11
Standard Deviation of Log Transformed Data 0.588

Normal Distribution Test Results

Correlation Coefficient R 0.583
Lilliefors Test Statistic 0.266
Lilliefors Critical (0.9) Value 0.052

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.701
A-D Test Statistic 4.403
A-D Critical (0.9) Value 0.64
K-S Test Statistic 0.0964
K-S Critical(0.9) Value 0.0547

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.982
Lilliefors Test Statistic 0.0371
Lilliefors Critical (0.9) Value 0.052

Data appear Lognormal at (0.1) Significance Level

Arsenic (aoc 1)

Raw Statistics

Number of Valid Observations	34
Number of Distinct Observations	31
Minimum	1.05
Maximum	24
Mean of Raw Data	9.31
Standard Deviation of Raw Data	5.621
Kstar	2.112
Mean of Log Transformed Data	1.998
Standard Deviation of Log Transformed Data	0.79

Normal Distribution Test Results

Correlation Coefficient R	0.969
Shapiro Wilk Test Statistic	0.934
Shapiro Wilk Critical (0.9) Value	0.943
Lilliefors Test Statistic	0.109
Lilliefors Critical (0.9) Value	0.138

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.982
A-D Test Statistic	0.526
A-D Critical (0.9) Value	0.637
K-S Test Statistic	0.0986
K-S Critical(0.9) Value	0.14

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.947
Shapiro Wilk Test Statistic	0.891
Shapiro Wilk Critical (0.9) Value	0.943
Lilliefors Test Statistic	0.141
Lilliefors Critical (0.9) Value	0.138

Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 18 and aoc 21)

Raw Statistics

Number of Valid Observations	42
Number of Distinct Observations	38
Minimum	0.666
Maximum	18.4
Mean of Raw Data	7.066
Standard Deviation of Raw Data	3.842
Kstar	2.793

Mean of Log Transformed Data 1.779
Standard Deviation of Log Transformed Data 0.666

Normal Distribution Test Results

Correlation Coefficient R 0.979
Shapiro Wilk Test Statistic 0.915
Shapiro Wilk Critical (0.9) Value 0.951
Lilliefors Test Statistic 0.118
Lilliefors Critical (0.9) Value 0.124

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.992
A-D Test Statistic 0.281
A-D Critical (0.9) Value 0.634
K-S Test Statistic 0.0846
K-S Critical(0.9) Value 0.126

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.961
Shapiro Wilk Test Statistic 0.893
Shapiro Wilk Critical (0.9) Value 0.951
Lilliefors Test Statistic 0.113
Lilliefors Critical (0.9) Value 0.124

Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 19)

Raw Statistics

Number of Valid Observations 32
Number of Distinct Observations 29
Minimum 4.3
Maximum 101
Mean of Raw Data 11.61
Standard Deviation of Raw Data 16.7
Kstar 1.729
Mean of Log Transformed Data 2.164
Standard Deviation of Log Transformed Data 0.602

Normal Distribution Test Results

Correlation Coefficient R 0.566
Shapiro Wilk Test Statistic 0.358
Shapiro Wilk Critical (0.9) Value 0.941
Lilliefors Test Statistic 0.371

Lilliefors Critical (0.9) Value 0.142

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.719

A-D Test Statistic 2.813

A-D Critical (0.9) Value 0.639

K-S Test Statistic 0.23

K-S Critical(0.9) Value 0.145

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.893

Shapiro Wilk Test Statistic 0.819

Shapiro Wilk Critical (0.9) Value 0.941

Lilliefors Test Statistic 0.139

Lilliefors Critical (0.9) Value 0.142

Data not Lognormal at (0.1) Significance Level

Arsenic (aoc 2 - ra)

Raw Statistics

Number of Valid Observations 20

Number of Distinct Observations 20

Minimum 0.181

Maximum 23.7

Mean of Raw Data 5.096

Standard Deviation of Raw Data 6.042

Kstar 0.71

Mean of Log Transformed Data 0.883

Standard Deviation of Log Transformed Data 1.41

Normal Distribution Test Results

Correlation Coefficient R 0.871

Shapiro Wilk Test Statistic 0.768

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.233

Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.992

A-D Test Statistic 0.3

A-D Critical (0.9) Value 0.651

K-S Test Statistic 0.149

K-S Critical(0.9) Value 0.184

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.98

Shapiro Wilk Test Statistic 0.95

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.137

Lilliefors Critical (0.9) Value 0.18

Data appear Lognormal at (0.1) Significance Level

Arsenic (background)

Raw Statistics

Number of Valid Observations 20

Number of Distinct Observations 19

Minimum 5.3

Maximum 68.5

Mean of Raw Data 16.16

Standard Deviation of Raw Data 15.99

Kstar 1.587

Mean of Log Transformed Data 2.485

Standard Deviation of Log Transformed Data 0.713

Normal Distribution Test Results

Correlation Coefficient R 0.806

Shapiro Wilk Test Statistic 0.663

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.334

Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.939

A-D Test Statistic 1.685

A-D Critical (0.9) Value 0.635

K-S Test Statistic 0.247

K-S Critical(0.9) Value 0.181

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.93

Shapiro Wilk Test Statistic 0.862

Shapiro Wilk Critical (0.9) Value 0.92

Lilliefors Test Statistic 0.204

Lilliefors Critical (0.9) Value 0.18

Data not Lognormal at (0.1) Significance Level

Arsenic (block a)

Raw Statistics

Number of Valid Observations 31
Number of Distinct Observations 21
Minimum 1.1
Maximum 9.4
Mean of Raw Data 3.394
Standard Deviation of Raw Data 2.43
Kstar 2.223
Mean of Log Transformed Data 1.003
Standard Deviation of Log Transformed Data 0.665

Normal Distribution Test Results

Correlation Coefficient R 0.909
Shapiro Wilk Test Statistic 0.815
Shapiro Wilk Critical (0.9) Value 0.94
Lilliefors Test Statistic 0.176
Lilliefors Critical (0.9) Value 0.145

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.972
A-D Test Statistic 0.702
A-D Critical (0.9) Value 0.636
K-S Test Statistic 0.114
K-S Critical(0.9) Value 0.146

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.976
Shapiro Wilk Test Statistic 0.931
Shapiro Wilk Critical (0.9) Value 0.94
Lilliefors Test Statistic 0.125
Lilliefors Critical (0.9) Value 0.145

Data not Lognormal at (0.1) Significance Level

Lead (aoc 1)

Raw Statistics

Number of Valid Observations 34
Number of Distinct Observations 34
Minimum 2.8

Maximum 3840
Mean of Raw Data 398.1
Standard Deviation of Raw Data 921.3
Kstar 0.355
Mean of Log Transformed Data 4.173
Standard Deviation of Log Transformed Data 1.91

Normal Distribution Test Results

Correlation Coefficient R 0.677
Shapiro Wilk Test Statistic 0.473
Shapiro Wilk Critical (0.9) Value 0.943
Lilliefors Test Statistic 0.385
Lilliefors Critical (0.9) Value 0.138

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.946
A-D Test Statistic 2.271
A-D Critical (0.9) Value 0.697
K-S Test Statistic 0.203
K-S Critical(0.9) Value 0.148

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.984
Shapiro Wilk Test Statistic 0.957
Shapiro Wilk Critical (0.9) Value 0.943
Lilliefors Test Statistic 0.0749
Lilliefors Critical (0.9) Value 0.138

Data appear Lognormal at (0.1) Significance Level

Lead (aoc 18 and aoc 21)

Raw Statistics

Number of Valid Observations 42
Number of Distinct Observations 40
Minimum 2.45
Maximum 93.5
Mean of Raw Data 12.29
Standard Deviation of Raw Data 14
Kstar 1.79
Mean of Log Transformed Data 2.224
Standard Deviation of Log Transformed Data 0.702

Normal Distribution Test Results

Correlation Coefficient R 0.681
Shapiro Wilk Test Statistic 0.491
Shapiro Wilk Critical (0.9) Value 0.951
Lilliefors Test Statistic 0.263
Lilliefors Critical (0.9) Value 0.124

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.808
A-D Test Statistic 1.135
A-D Critical (0.9) Value 0.639
K-S Test Statistic 0.134
K-S Critical(0.9) Value 0.127

Data follow Appr. Gamma Distribution at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.97
Shapiro Wilk Test Statistic 0.905
Shapiro Wilk Critical (0.9) Value 0.951
Lilliefors Test Statistic 0.117
Lilliefors Critical (0.9) Value 0.124

Data not Lognormal at (0.1) Significance Level

Lead (aoc 19)

Raw Statistics

Number of Valid Observations 32
Number of Distinct Observations 28
Minimum 5
Maximum 435
Mean of Raw Data 31.42
Standard Deviation of Raw Data 75.63
Kstar 0.762
Mean of Log Transformed Data 2.724
Standard Deviation of Log Transformed Data 0.97

Normal Distribution Test Results

Correlation Coefficient R 0.538
Shapiro Wilk Test Statistic 0.325
Shapiro Wilk Critical (0.9) Value 0.941
Lilliefors Test Statistic 0.396
Lilliefors Critical (0.9) Value 0.142

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.769
A-D Test Statistic 3.138
A-D Critical (0.9) Value 0.656
K-S Test Statistic 0.274
K-S Critical(0.9) Value 0.148
Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.921
Shapiro Wilk Test Statistic 0.857
Shapiro Wilk Critical (0.9) Value 0.941
Lilliefors Test Statistic 0.148
Lilliefors Critical (0.9) Value 0.142
Data not Lognormal at (0.1) Significance Level

Lead (aoc 2 - ra)

Raw Statistics
Number of Valid Observations 20
Number of Distinct Observations 20
Minimum 0.303
Maximum 336
Mean of Raw Data 30.39
Standard Deviation of Raw Data 78.61
Kstar 0.405
Mean of Log Transformed Data 1.928
Standard Deviation of Log Transformed Data 1.553

Normal Distribution Test Results

Correlation Coefficient R 0.614
Shapiro Wilk Test Statistic 0.402
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.456
Lilliefors Critical (0.9) Value 0.18
Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.903
A-D Test Statistic 2.24
A-D Critical (0.9) Value 0.679
K-S Test Statistic 0.311
K-S Critical(0.9) Value 0.189
Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.958
Shapiro Wilk Test Statistic 0.932
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.161
Lilliefors Critical (0.9) Value 0.18

Data appear Lognormal at (0.1) Significance Level

Lead (background)

Raw Statistics

Number of Valid Observations 20
Number of Distinct Observations 20
Minimum 9.7
Maximum 2230
Mean of Raw Data 163.4
Standard Deviation of Raw Data 492
Kstar 0.409
Mean of Log Transformed Data 3.629
Standard Deviation of Log Transformed Data 1.375

Normal Distribution Test Results

Correlation Coefficient R 0.55
Shapiro Wilk Test Statistic 0.331
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.406
Lilliefors Critical (0.9) Value 0.18

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R 0.846
A-D Test Statistic 2.801
A-D Critical (0.9) Value 0.678
K-S Test Statistic 0.279
K-S Critical(0.9) Value 0.189

Data not Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R 0.908
Shapiro Wilk Test Statistic 0.83
Shapiro Wilk Critical (0.9) Value 0.92
Lilliefors Test Statistic 0.18
Lilliefors Critical (0.9) Value 0.18

Data not Lognormal at (0.1) Significance Level

Lead (block a)

Raw Statistics

Number of Valid Observations	31
Number of Distinct Observations	30
Minimum	1.9
Maximum	34.3
Mean of Raw Data	12.44
Standard Deviation of Raw Data	9.45
Kstar	1.745
Mean of Log Transformed Data	2.236
Standard Deviation of Log Transformed Data	0.785

Normal Distribution Test Results

Correlation Coefficient R	0.927
Shapiro Wilk Test Statistic	0.848
Shapiro Wilk Critical (0.9) Value	0.94
Lilliefors Test Statistic	0.172
Lilliefors Critical (0.9) Value	0.145

Data not Normal at (0.1) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.969
A-D Test Statistic	0.688
A-D Critical (0.9) Value	0.638
K-S Test Statistic	0.145
K-S Critical(0.9) Value	0.147

Data appear Gamma Distributed at (0.1) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.984
Shapiro Wilk Test Statistic	0.955
Shapiro Wilk Critical (0.9) Value	0.94
Lilliefors Test Statistic	0.123
Lilliefors Critical (0.9) Value	0.145

Data appear Lognormal at (0.1) Significance Level

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Aluminum(aoc 13)

Background Data: Aluminum(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	25	11
Minimum	4920	3910
Maximum	36100	17400
Mean	12181	8493
Median	12600	7350
SD	6901	4233
SE of Mean	1328	1276

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indi_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	6116
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Aluminum(aoc 13)

Background Data: Aluminum(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	25	11
Minimum	4920	3910
Maximum	36100	17400
Mean	12181	8493
Median	12600	7350
SD	6901	4233
SE of Mean	1328	1276

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 6116

Site Rank Sum W-Stat	479
WMW Test U-Stat	101
WMW Critical Value (0.100)	79
Approximate P-Value	0.0652

Conclusion with Alpha = 0.10

Do Not Reject H0, Conclude Site >= Background + 6116.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 13)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	26	11
Minimum	0.178	5.9
Maximum	14.8	68.5
Mean	7.238	19.78
Median	6.9	10.9
SD	2.975	19.63
SE of Mean	0.573	5.917

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	32
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Arsenic(aoc 13)
Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	26	11
Minimum	0.178	5.9
Maximum	14.8	68.5
Mean	7.238	19.78
Median	6.9	10.9
SD	2.975	19.63
SE of Mean	0.573	5.917

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 32

Site Rank Sum W-Stat	378
WMW Test U-Stat	0
WMW Critical Value (0.100)	79
Approximate P-Value	9.505E-07

Conclusion with Alpha = 0.10
Reject H0, Conclude Site < Background + 32.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Iron(aoc 13)

Background Data: Iron(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	25	11
Minimum	2200	13600
Maximum	185000	132000
Mean	22602	28309
Median	15000	17400
SD	33010	34564
SE of Mean	6353	10421

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	18101
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Iron(aoc 13)

Background Data: Iron(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	25	11
Minimum	2200	13600
Maximum	185000	132000
Mean	22602	28309
Median	15000	17400
SD	33010	34564
SE of Mean	6353	10421

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 18101

Site Rank Sum W-Stat	389
WMW Test U-Stat	11
WMW Critical Value (0.100)	79
Approximate P-Value	5.178E-06

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 18101.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 13)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	26	11
Minimum	1.53	13.25
Maximum	464	2230
Mean	53.95	257.3
Median	20.3	42.5
SD	105.3	657.2
SE of Mean	20.27	198.1

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL\F
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	376
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Lead(aoc 13)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	26	11
Minimum	1.53	13.25
Maximum	464	2230
Mean	53.95	257.3
Median	20.3	42.5
SD	105.3	657.2
SE of Mean	20.27	198.1

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 376

Site Rank Sum W-Stat	386
WMW Test U-Stat	8
WMW Critical Value (0.100)	79
Approximate P-Value	3.3003E-06

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 376.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Manganese(aoc 13)

Background Data: Manganese(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	27	11
Minimum	318	278
Maximum	4200	2270
Mean	991.6	833.2
Median	755	820
SD	871.5	519.6
SE of Mean	167.7	156.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	238
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Manganese(aoc 13)

Background Data: Manganese(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	27	11
Minimum	318	278
Maximum	4200	2270
Mean	991.6	833.2
Median	755	820
SD	871.5	519.6
SE of Mean	167.7	156.7

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 238

Site Rank Sum W-Stat	477
WMW Test U-Stat	99
WMW Critical Value (0.100)	79
Approximate P-Value	0.0574

Conclusion with Alpha = 0.10

Do Not Reject H0, Conclude Site >= Background + 238.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indi_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium(aoc 13)

Background Data: Vanadium(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	27	11
Minimum	5.24	10.7
Maximum	45	35
Mean	22.36	21.54
Median	18.1	21.2
SD	10.25	8.431
SE of Mean	1.973	2.542

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.107

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	10
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Vanadium(aoc 13)

Background Data: Vanadium(background)

Raw Statistics

	Site	Background
Number of Valid Observations	27	11
Number of Distinct Observations	27	11
Minimum	5.24	10.7
Maximum	45	35
Mean	22.36	21.54
Median	18.1	21.2
SD	10.25	8.431
SE of Mean	1.973	2.542

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 10

Site Rank Sum W-Stat	444.5
WMW Test U-Stat	66.5
WMW Critical Value (0.100)	79
Approximate P-Value	0.00435

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 10.00

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: BAP-TE(aoc 13)

Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	27	10
Number of Missing Values	0	1
Number of Non-Detect Data	2	1
Number of Detect Data	25	9
Minimum Non-Detect	0.901	0.901
Maximum Non-Detect	0.948	0.901
Percent Non detects	7.41%	10.00%
Minimum Detected	0.251	0.238
Maximum Detected	59.68	10.43
Mean of Detected Data	6.969	2.448
Median of Detected Data	0.791	1.182
SD of Detected Data	14.04	3.275

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	6
Approximate K Value (0.109)	6
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.127

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options	
From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	4.4
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: BAP-TE(aoc 13)

Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	27	10
Number of Missing Values	0	1
Number of Non-Detect Data	2	1
Number of Detect Data	25	9
Minimum Non-Detect	0.901	0.901
Maximum Non-Detect	0.948	0.901
Percent Non detects	7.41%	10.00%
Minimum Detected	0.251	0.238
Maximum Detected	59.68	10.43
Mean of Detected Data	6.969	2.448
Median of Detected Data	0.791	1.182
SD of Detected Data	14.04	3.275

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 4.4

Gehan z Test Value	-2.186
Critical z (0.90)	-1.282
P-Value	0.0144

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 4.40

P-Value < alpha (0.1)

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Aluminum(aoc 22)

Background Data: Aluminum(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	3020	3910
Maximum	19200	17400
Mean	9541	8493
Median	8215	7350
SD	4354	4233
SE of Mean	1026	1276

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0721

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	6116
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Aluminum(aoc 22)

Background Data: Aluminum(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	3020	3910
Maximum	19200	17400
Mean	9541	8493
Median	8215	7350
SD	4354	4233
SE of Mean	1026	1276

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 6116

Site Rank Sum W-Stat	209
WMW Test U-Stat	38
WMW Critical Value (0.100)	70
Approximate P-Value	0.00327

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 6116.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 22)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	3.26	5.9
Maximum	14.3	68.5
Mean	8.049	19.78
Median	6.39	10.9
SD	3.454	19.63
SE of Mean	0.814	5.917

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.0721

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	32
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Arsenic(aoc 22)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	3.26	5.9
Maximum	14.3	68.5
Mean	8.049	19.78
Median	6.39	10.9
SD	3.454	19.63
SE of Mean	0.814	5.917

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 32

Site Rank Sum W-Stat	171
WMW Test U-Stat	0
WMW Critical Value (0.100)	70
Approximate P-Value	4.772E-06

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 32.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Iron(aoc 22)

Background Data: Iron(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	8940	13600
Maximum	69200	132000
Mean	31036	28309
Median	24250	17400
SD	19544	34564
SE of Mean	4607	10421

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0721

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	18101
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Iron(aoc 22)

Background Data: Iron(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	8940	13600
Maximum	69200	132000
Mean	31036	28309
Median	24250	17400
SD	19544	34564
SE of Mean	4607	10421

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 18101

Site Rank Sum W-Stat	237
WMW Test U-Stat	66
WMW Critical Value (0.100)	70
Approximate P-Value	0.072

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 18101.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 22)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	17	11
Number of Missing Values	1	0
Number of Distinct Observations	17	11
Minimum	10.2	13.25
Maximum	341	2230
Mean	107.1	257.3
Median	66.3	42.5
SD	109.4	657.2
SE of Mean	26.54	198.1

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	4
Approximate K Value (0.109)	4
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.116

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	376
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Lead(aoc 22)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	17	11
Number of Missing Values	1	0
Number of Distinct Observations	17	11
Minimum	10.2	13.25
Maximum	341	2230
Mean	107.1	257.3
Median	66.3	42.5
SD	109.4	657.2
SE of Mean	26.54	198.1

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 376

Site Rank Sum W-Stat	153
WMW Test U-Stat	0
WMW Critical Value (0.100)	66
Approximate P-Value	6.078E-06

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 376.00

Non-parametric Quantile Hypothosis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Manganese(aoc 22)

Background Data: Manganese(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	236	278
Maximum	3180	2270
Mean	1118	833.2
Median	804.5	820
SD	908.1	519.6
SE of Mean	214	156.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0721

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	238
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Manganese(aoc 22)

Background Data: Manganese(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	236	278
Maximum	3180	2270
Mean	1118	833.2
Median	804.5	820
SD	908.1	519.6
SE of Mean	214	156.7

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 238

Site Rank Sum W-Stat	248
WMW Test U-Stat	77
WMW Critical Value (0.100)	70
Approximate P-Value	0.167

Conclusion with Alpha = 0.10

Do Not Reject H0, Conclude Site >= Background + 238.00

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options	
From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium(aoc 22)

Background Data: Vanadium(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	7.55	10.7
Maximum	30.5	35
Mean	16.68	21.54
Median	15	21.2
SD	6.958	8.431
SE of Mean	1.64	2.542

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0721

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference (S)	7
Selected Null Hypothesis	Site or AOC Mean Greater Than or Equal to Background Mean + Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean Less Than the Background Mean + S

Area of Concern Data: Vanadium(aoc 22)

Background Data: Vanadium(background)

Raw Statistics

	Site	Background
Number of Valid Observations	18	11
Number of Distinct Observations	18	11
Minimum	7.55	10.7
Maximum	30.5	35
Mean	16.68	21.54
Median	15	21.2
SD	6.958	8.431
SE of Mean	1.64	2.542

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background >= 7.00

Method	DF	t-Test Value	Critical - t (0.100)	P-Value
Pooled (Equal Variance)	27	-4.112	2.7E+308	0
Satterthwaite (Unequal Variance)	18.2	-3.921	2.7E+308	0

Pooled SD: 7.537

Conclusion with Alpha = 0.100

* Student t (Pooled): Do Not Reject H0, Conclude Site >= Background + 7.00
* Satterthwaite: Do Not Reject H0, Conclude Site >= Background + 7.00

Test of Equality of Variances

Numerator DF	Denominator DF	F-Test Value	P-Value
10	17	1.468	0.467

Conclusion with Alpha = 0.10

* Two variances appear to be equal

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indi_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: BAP-TE(aoc 22)

Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	18	10
Number of Missing Values	0	1
Number of Non-Detect Data	0	1
Number of Detect Data	18	9
Minimum Non-Detect	N/A	0.901
Maximum Non-Detect	N/A	0.901
Percent Non detects	0.00%	10.00%
Minimum Detected	0.453	0.238
Maximum Detected	52.79	10.43
Mean of Detected Data	8.775	2.448
Median of Detected Data	1.263	1.182
SD of Detected Data	17.07	3.275

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.109)	5
Approximate K Value (0.109)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0872

Conclusion with Alpha = 0.109

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference (S)	4.4
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: BAP-TE(aoc 22)

Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	18	10
Number of Missing Values	0	1
Number of Non-Detect Data	0	1
Number of Detect Data	18	9
Minimum Non-Detect	N/A	0.901
Maximum Non-Detect	N/A	0.901
Percent Non detects	0.00%	10.00%
Minimum Detected	0.453	0.238
Maximum Detected	52.79	10.43
Mean of Detected Data	8.775	2.448
Median of Detected Data	1.263	1.182
SD of Detected Data	17.07	3.275

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 0.901 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 4.4

Site Rank Sum W-Stat	208
WMW Test U-Stat	37
WMW Critical Value (0.100)	63
Approximate P-Value	0.00591

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 4.40

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Aluminum(s. exposure area rev)

Background Data: Aluminum(background)

Raw Statistics

	Site	Background
Number of Valid Observations	121	11
Number of Missing Values	21	0
Number of Distinct Observations	106	11
Minimum	4260	3910
Maximum	90200	17400
Mean	19217	8493
Median	16700	7350
SD	11216	4233
SE of Mean	1020	1276

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	1
Calculated Alpha	1

Conclusion with Alpha = 0

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(s. exposure area rev)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	121	11
Number of Missing Values	21	0
Number of Non-Detect Data	8	0
Number of Detect Data	113	11
Minimum Non-Detect	1	N/A
Maximum Non-Detect	5.5	N/A
Percent Non detects	6.61%	0.00%
Minimum Detected	0.474	5.9
Maximum Detected	33.6	68.5
Mean of Detected Data	9.28	19.78
Median of Detected Data	8.8	10.9
SD of Detected Data	6.067	19.63

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	0
Calculated Alpha	1

Conclusion with Alpha = 0

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	32
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(s. exposure area rev)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	121	11
Number of Missing Values	21	0
Number of Non-Detect Data	8	0
Number of Detect Data	113	11
Minimum Non-Detect	1	N/A
Maximum Non-Detect	5.5	N/A
Percent Non detects	6.61%	0.00%
Minimum Detected	0.474	5.9
Maximum Detected	33.6	68.5
Mean of Detected Data	9.28	19.78
Median of Detected Data	8.8	10.9
SD of Detected Data	6.067	19.63

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 32

Gehan z Test Value	-5.485
Critical z (0.90)	-1.282
P-Value	2.064E-08

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 32.00

P-Value < alpha (0.1)

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indi_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Iron(s. exposure area rev)

Background Data: Iron(background)

Raw Statistics

	Site	Background
Number of Valid Observations	121	11
Number of Missing Values	21	0
Number of Distinct Observations	110	11
Minimum	4805	13600
Maximum	170000	132000
Mean	45797	28309
Median	27100	17400
SD	39323	34564
SE of Mean	3575	10421

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	1
Calculated Alpha	1

Conclusion with Alpha = 0

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(s. exposure area rev)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	121	11
Number of Missing Values	21	0
Number of Non-Detect Data	2	0
Number of Detect Data	119	11
Minimum Non-Detect	5.1	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	1.65%	0.00%
Minimum Detected	1.86	13.25
Maximum Detected	1330	2230
Mean of Detected Data	77.1	257.3
Median of Detected Data	25.8	42.5
SD of Detected Data	144.4	657.2

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	0
Calculated Alpha	1

Conclusion with Alpha = 0

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	376
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(s. exposure area rev)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	121	11
Number of Missing Values	21	0
Number of Non-Detect Data	2	0
Number of Detect Data	119	11
Minimum Non-Detect	5.1	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	1.65%	0.00%
Minimum Detected	1.86	13.25
Maximum Detected	1330	2230
Mean of Detected Data	77.1	257.3
Median of Detected Data	25.8	42.5
SD of Detected Data	144.4	657.2

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 376

Gehan z Test Value	-5.299
Critical z (0.90)	-1.282
P-Value	5.835E-08

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 376.00

P-Value < alpha (0.1)

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Manganese(s. exposure area rev)
Background Data: Manganese(background)

Raw Statistics

	Site	Background
Number of Valid Observations	121	11
Number of Missing Values	21	0
Number of Distinct Observations	116	11
Minimum	337	278
Maximum	20700	2270
Mean	3031	833.2
Median	2160	820
SD	2976	519.6
SE of Mean	270.6	156.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	1
Calculated Alpha	1

Conclusion with Alpha = 0

Reject H0, Conclude Site Concentration > Background Concentration

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options	
From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium(s. exposure area rev)

Background Data: Vanadium(background)

Raw Statistics

	Site	Background
Number of Valid Observations	121	11
Number of Missing Values	21	0
Number of Distinct Observations	107	11
Minimum	8.4	10.7
Maximum	485	35
Mean	33.23	21.54
Median	25.6	21.2
SD	45.32	8.431
SE of Mean	4.12	2.542

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	1
Calculated Alpha	1

Conclusion with Alpha = 0

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: BAP-TE(a. exposure area rev)
Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	119	10
Number of Missing Values	23	1
Number of Non-Detect Data	7	1
Number of Detect Data	112	9
Minimum Non-Detect	0.855	0.901
Maximum Non-Detect	90.13	0.901
Percent Non detects	5.88%	10.00%
Minimum Detected	0.182	0.238
Maximum Detected	40	10.43
Mean of Detected Data	3.032	2.448
Median of Detected Data	1.032	1.182
SD of Detected Data	5.338	3.275

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0)	0
Approximate K Value (0)	0
R Value Adjusted for Ties in Data	1
K Value Adjusted for Ties in Data	1
Number of Site Observations in 'R' Largest	1

Non-Detect Values in the 'R' Largest - Cannot complete Quantile Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	4.4
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: BAP-TE(s. exposure area rev)

Background Data: BAP-TE(background)

Raw Statistics

	Site	Background
Number of Valid Data	119	10
Number of Missing Values	23	1
Number of Non-Detect Data	7	1
Number of Detect Data	112	9
Minimum Non-Detect	0.855	0.901
Maximum Non-Detect	90.13	0.901
Percent Non detects	5.88%	10.00%
Minimum Detected	0.182	0.238
Maximum Detected	40	10.43
Mean of Detected Data	3.032	2.448
Median of Detected Data	1.032	1.182
SD of Detected Data	5.338	3.275

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 4.4

Gehan z Test Value	-3.387
Critical z (0.90)	-1.282
P-Value	0.0003538

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 4.40

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 1)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	34	20
Number of Non-Detect Data	3	0
Number of Detect Data	31	20
Minimum Non-Detect	1.05	N/A
Maximum Non-Detect	1.2	N/A
Percent Non detects	8.82%	0.00%
Minimum Detected	2.2	5.3
Maximum Detected	24	68.5
Mean of Detected Data	10.1	16.16
Median of Detected Data	8.8	9.75
SD of Detected Data	5.233	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.093)	5
Approximate K Value (0.093)	5
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.088

Conclusion with Alpha = 0.093

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 1)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	34	20
Number of Non-Detect Data	3	0
Number of Detect Data	31	20
Minimum Non-Detect	1.05	N/A
Maximum Non-Detect	1.2	N/A
Percent Non detects	8.82%	0.00%
Minimum Detected	2.2	5.3
Maximum Detected	24	68.5
Mean of Detected Data	10.1	16.16
Median of Detected Data	8.8	9.75
SD of Detected Data	5.233	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-6.091
Critical z (0.90)	-1.282
P-Value	5.621E-10

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 1)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	34	20
Number of Non-Detect Data	1	0
Number of Detect Data	33	20
Minimum Non-Detect	5.3	N/A
Maximum Non-Detect	5.3	N/A
Percent Non detects	2.94%	0.00%
Minimum Detected	2.8	9.7
Maximum Detected	3840	2230
Mean of Detected Data	410	163.4
Median of Detected Data	57	22.35
SD of Detected Data	932.9	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.093)	5
Approximate K Value (0.093)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.088

Conclusion with Alpha = 0.093

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options	
From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference (S)	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(aoc 1)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	34	20
Number of Non-Detect Data	1	0
Number of Detect Data	33	20
Minimum Non-Detect	5.3	N/A
Maximum Non-Detect	5.3	N/A
Percent Non detects	2.94%	0.00%
Minimum Detected	2.8	9.7
Maximum Detected	3840	2230
Mean of Detected Data	410	163.4
Median of Detected Data	57	22.35
SD of Detected Data	932.9	492

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 160

Site Rank Sum W-Stat	N/A
WMW Test U-Stat	N/A
WMW Critical Value (0.100)	152
Approximate P-Value	N/A

Conclusion with Alpha = 0.10

Do Not Reject H0, Conclude Site >= Background + 160.00

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(aoc 1)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	34	20
Number of Non-Detect Data	1	0
Number of Detect Data	33	20
Minimum Non-Detect	5.3	N/A
Maximum Non-Detect	5.3	N/A
Percent Non detects	2.94%	0.00%
Minimum Detected	2.8	9.7
Maximum Detected	3840	2230
Mean of Detected Data	410	163.4
Median of Detected Data	57	22.35
SD of Detected Data	932.9	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value	-3.278
Critical z (0.90)	-1.282
P-Value	0.0005224

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 2 - ra)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	20	20
Number of Non-Detect Data	2	0
Number of Detect Data	18	20
Minimum Non-Detect	0.181	N/A
Maximum Non-Detect	0.2	N/A
Percent Non detects	10.00%	0.00%
Minimum Detected	0.515	5.3
Maximum Detected	23.7	68.5
Mean of Detected Data	5.641	16.16
Median of Detected Data	3.99	9.75
SD of Detected Data	6.137	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.115)	3
Approximate K Value (0.115)	3
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.115

Conclusion with Alpha = 0.115

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 2 - ra)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	20	20
Number of Non-Detect Data	2	0
Number of Detect Data	18	20
Minimum Non-Detect	0.181	N/A
Maximum Non-Detect	0.2	N/A
Percent Non detects	10.00%	0.00%
Minimum Detected	0.515	5.3
Maximum Detected	23.7	68.5
Mean of Detected Data	5.641	16.16
Median of Detected Data	3.99	9.75
SD of Detected Data	6.137	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-5.41
Critical z (0.90)	-1.282
P-Value	3.147E-08

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 2 - ra)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	20	20
Number of Distinct Observations	20	20
Minimum	0.303	9.7
Maximum	336	2230
Mean	30.39	163.4
Median	6.785	22.35
SD	78.61	492
SE of Mean	17.58	110

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.115)	3
Approximate K Value (0.115)	3
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.115

Conclusion with Alpha = 0.115

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Lead(aoc 2 - ra)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Observations	20	20
Number of Distinct Observations	20	20
Minimum	0.303	9.7
Maximum	336	2230
Mean	30.39	163.4
Median	6.785	22.35
SD	78.61	492
SE of Mean	17.58	110

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 160

Site Rank Sum W-Stat	227
WMW Test U-Stat	17
WMW Critical Value (0.100)	152
Approximate P-Value	3.974E-07

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 18 and aoc 21)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	42	20
Number of Non-Detect Data	1	0
Number of Detect Data	41	20
Minimum Non-Detect	1.1	N/A
Maximum Non-Detect	1.1	N/A
Percent Non detects	2.38%	0.00%
Minimum Detected	0.666	5.3
Maximum Detected	18.4	68.5
Mean of Detected Data	7.212	16.16
Median of Detected Data	6.8	9.75
SD of Detected Data	3.771	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.084)	10
Approximate K Value (0.084)	9
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.0966

Conclusion with Alpha = 0.084

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference (S)	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 18 and aoc 21)
Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	42	20
Number of Non-Detect Data	1	0
Number of Detect Data	41	20
Minimum Non-Detect	1.1	N/A
Maximum Non-Detect	1.1	N/A
Percent Non detects	2.38%	0.00%
Minimum Detected	0.666	5.3
Maximum Detected	18.4	68.5
Mean of Detected Data	7.212	16.16
Median of Detected Data	6.8	9.75
SD of Detected Data	3.771	15.99

Wilcoxon-Mann-Whitney Site vs Background Test
Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 24

Site Rank Sum W-Stat	N/A
WMW Test U-Stat	N/A
WMW Critical Value (0.100)	152
Approximate P-Value	N/A

Conclusion with Alpha = 0.10
Do Not Reject H0, Conclude Site >= Background + 24.00

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 18 and aoc 21)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	42	20
Number of Non-Detect Data	1	0
Number of Detect Data	41	20
Minimum Non-Detect	1.1	N/A
Maximum Non-Detect	1.1	N/A
Percent Non detects	2.38%	0.00%
Minimum Detected	0.666	5.3
Maximum Detected	18.4	68.5
Mean of Detected Data	7.212	16.16
Median of Detected Data	6.8	9.75
SD of Detected Data	3.771	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-6.325
Critical z (0.90)	-1.282
P-Value	1.269E-10

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 18 and aoc 21)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	42	20
Number of Non-Detect Data	4	0
Number of Detect Data	38	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	9.52%	0.00%
Minimum Detected	2.45	9.7
Maximum Detected	93.5	2230
Mean of Detected Data	13.02	163.4
Median of Detected Data	11.7	22.35
SD of Detected Data	14.54	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.084)	10
Approximate K Value (0.084)	9
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.0966

Conclusion with Alpha = 0.084

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(aoc 18 and aoc 21)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	42	20
Number of Non-Detect Data	4	0
Number of Detect Data	38	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	9.52%	0.00%
Minimum Detected	2.45	9.7
Maximum Detected	93.5	2230
Mean of Detected Data	13.02	163.4
Median of Detected Data	11.7	22.35
SD of Detected Data	14.54	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value	-6.338
Critical z (0.90)	-1.282
P-Value	1.166E-10

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

Non-parametric Quantile Hypothesis Test for Full Dataset (No NDs)

User Selected Options	
From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 19)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	32	20
Number of Distinct Observations	29	19
Minimum	4.3	5.3
Maximum	101	68.5
Mean	11.61	16.16
Median	8.35	9.75
SD	16.7	15.99
SE of Mean	2.953	3.576

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.119)	4
Approximate K Value (0.119)	4
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.133

Conclusion with Alpha = 0.119

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney Ranked Sum Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median >= Background Mean/Median Plus Substantial Difference, S (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median Plus Substantial Difference, S

Area of Concern Data: Arsenic(aoc 19)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Observations	32	20
Number of Distinct Observations	29	19
Minimum	4.3	5.3
Maximum	101	68.5
Mean	11.61	16.16
Median	8.35	9.75
SD	16.7	15.99
SE of Mean	2.953	3.576

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 24

Site Rank Sum W-Stat	548
WMW Test U-Stat	20
WMW Critical Value (0.100)	152
Approximate P-Value	8.842E-09

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 19)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	32	20
Number of Non-Detect Data	6	0
Number of Detect Data	26	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.3	N/A
Percent Non detects	18.75%	0.00%
Minimum Detected	5	9.7
Maximum Detected	435	2230
Mean of Detected Data	37.47	163.4
Median of Detected Data	18.9	22.35
SD of Detected Data	83.01	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.119)	4
Approximate K Value (0.119)	4
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.133

Conclusion with Alpha = 0.119

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(aoc 19)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	32	20
Number of Non-Detect Data	6	0
Number of Detect Data	26	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.3	N/A
Percent Non detects	18.75%	0.00%
Minimum Detected	5	9.7
Maximum Detected	435	2230
Mean of Detected Data	37.47	163.4
Median of Detected Data	18.9	22.35
SD of Detected Data	83.01	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value	-5.687
Critical z (0.90)	-1.282
P-Value	6.466E-09

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(block a)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	31	20
Number of Non-Detect Data	6	0
Number of Detect Data	25	20
Minimum Non-Detect	1.1	N/A
Maximum Non-Detect	1.3	N/A
Percent Non detects	19.35%	0.00%
Minimum Detected	1.2	5.3
Maximum Detected	9.4	68.5
Mean of Detected Data	3.928	16.16
Median of Detected Data	3.1	9.75
SD of Detected Data	2.417	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.119)	4
Approximate K Value (0.119)	4
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.126

Conclusion with Alpha = 0.119

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(block a)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	31	20
Number of Non-Detect Data	6	0
Number of Detect Data	25	20
Minimum Non-Detect	1.1	N/A
Maximum Non-Detect	1.3	N/A
Percent Non detects	19.35%	0.00%
Minimum Detected	1.2	5.3
Maximum Detected	9.4	68.5
Mean of Detected Data	3.928	16.16
Median of Detected Data	3.1	9.75
SD of Detected Data	2.417	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-5.986
Critical z (0.90)	-1.282
P-Value	1.073E-09

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(block a)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	31	20
Number of Non-Detect Data	2	0
Number of Detect Data	29	20
Minimum Non-Detect	5.3	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	6.45%	0.00%
Minimum Detected	1.9	9.7
Maximum Detected	34.3	2230
Mean of Detected Data	12.92	163.4
Median of Detected Data	11.4	22.35
SD of Detected Data	9.592	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.119)	4
Approximate K Value (0.119)	4
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.126

Conclusion with Alpha = 0.119

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(block a)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	31	20
Number of Non-Detect Data	2	0
Number of Detect Data	29	20
Minimum Non-Detect	5.3	N/A
Maximum Non-Detect	5.7	N/A
Percent Non detects	6.45%	0.00%
Minimum Detected	1.9	9.7
Maximum Detected	34.3	2230
Mean of Detected Data	12.92	163.4
Median of Detected Data	11.4	22.35
SD of Detected Data	9.592	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value -5.994

Critical z (0.90) -1.282

P-Value 1.022E-09

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(aoc 13)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	79	20
Number of Non-Detect Data	1	0
Number of Detect Data	78	20
Minimum Non-Detect	0.381	N/A
Maximum Non-Detect	0.381	N/A
Percent Non detects	1.27%	0.00%
Minimum Detected	0.178	5.3
Maximum Detected	38.7	68.5
Mean of Detected Data	7.659	16.16
Median of Detected Data	6.5	9.75
SD of Detected Data	5.492	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.095)	10
Approximate K Value (0.095)	10
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.0925

Conclusion with Alpha = 0.095

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference (S)	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 13)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	79	20
Number of Non-Detect Data	1	0
Number of Detect Data	78	20
Minimum Non-Detect	0.381	N/A
Maxdmum Non-Detect	0.381	N/A
Percent Non detects	1.27%	0.00%
Minimum Detected	0.178	5.3
Maximum Detected	38.7	68.5
Mean of Detected Data	7.659	16.16
Median of Detected Data	6.5	9.75
SD of Detected Data	5.492	15.99

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background + 24

Site Rank Sum W-Stat	N/A
WMW Test U-Stat	N/A
WMW Critical Value (0.100)	152
Approximate P-Value	N/A

Conclusion with Alpha = 0.10

Do Not Reject H0, Conclude Site >= Background + 24.00

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(aoc 13)

Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	79	20
Number of Non-Detect Data	1	0
Number of Detect Data	78	20
Minimum Non-Detect	0.381	N/A
Maximum Non-Detect	0.381	N/A
Percent Non detects	1.27%	0.00%
Minimum Detected	0.178	5.3
Maximum Detected	38.7	68.5
Mean of Detected Data	7.659	16.16
Median of Detected Data	6.5	9.75
SD of Detected Data	5.492	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-6.754
Critical z (0.90)	-1.282
P-Value	7.188E-12

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(aoc 13)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	79	20
Number of Non-Detect Data	18	0
Number of Detect Data	61	20
Minimum Non-Detect	0.254	N/A
Maximum Non-Detect	5.9	N/A
Percent Non detects	22.78%	0.00%
Minimum Detected	1.53	9.7
Maximum Detected	464	2230
Mean of Detected Data	52.45	163.4
Median of Detected Data	20.3	22.35
SD of Detected Data	90.48	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.095)	10
Approximate K Value (0.095)	10
Number of Site Observations in 'R' Largest	7
Calculated Alpha	0.0925

Conclusion with Alpha = 0.095

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(aoc 13)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	79	20
Number of Non-Detect Data	18	0
Number of Detect Data	61	20
Minimum Non-Detect	0.254	N/A
Maximum Non-Detect	5.9	N/A
Percent Non detects	22.78%	0.00%
Minimum Detected	1.53	9.7
Maximum Detected	464	2230
Mean of Detected Data	52.45	163.4
Median of Detected Data	20.3	22.35
SD of Detected Data	90.48	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value	-6.297
Critical z (0.90)	-1.282
P-Value	1.515E-10

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Arsenic(s. exposure area rev)
Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	240	20
Number of Missing Values	48	0
Number of Non-Detect Data	13	0
Number of Detect Data	227	20
Minimum Non-Detect	1	N/A
Maximum Non-Detect	5.5	N/A
Percent Non detects	5.42%	0.00%
Minimum Detected	0.474	5.3
Maximum Detected	50.95	68.5
Mean of Detected Data	9.041	16.16
Median of Detected Data	8.4	9.75
SD of Detected Data	6.762	15.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.1)	12
Approximate K Value (0.1)	12
Number of Site Observations in 'R' Largest	8
Calculated Alpha	N/A

Conclusion with Alpha = 0.1
Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	24
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Arsenic(s. exposure area rev)
Background Data: Arsenic(background)

Raw Statistics

	Site	Background
Number of Valid Data	240	20
Number of Missing Values	48	0
Number of Non-Detect Data	13	0
Number of Detect Data	227	20
Minimum Non-Detect	1	N/A
Maximum Non-Detect	5.5	N/A
Percent Non detects	5.42%	0.00%
Minimum Detected	0.474	5.3
Maximum Detected	50.95	68.5
Mean of Detected Data	9.041	16.16
Median of Detected Data	8.4	9.75
SD of Detected Data	6.762	15.99

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 24

Gehan z Test Value	-7.281
Critical z (0.90)	-1.282
P-Value	1.656E-13

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 24.00

P-Value < alpha (0.1)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead(s. exposure area rev)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	240	20
Number of Missing Values	48	0
Number of Non-Detect Data	12	0
Number of Detect Data	228	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.9	N/A
Percent Non detects	5.00%	0.00%
Minimum Detected	1.86	9.7
Maximum Detected	1330	2230
Mean of Detected Data	56.14	163.4
Median of Detected Data	20.85	22.35
SD of Detected Data	111.9	492

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.1)	12
Approximate K Value (0.1)	12
Number of Site Observations in 'R' Largest	10
Calculated Alpha	N/A

Conclusion with Alpha = 0.1

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background Evaluation\ProUCL
Full Precision	OFF
Confidence Coefficient	90%
Substantial Difference	160
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median plus a Substantial Difference, S (
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median plus a Substantial Difference, S

Area of Concern Data: Lead(s. exposure area rev)

Background Data: Lead(background)

Raw Statistics

	Site	Background
Number of Valid Data	240	20
Number of Missing Values	48	0
Number of Non-Detect Data	12	0
Number of Detect Data	228	20
Minimum Non-Detect	5	N/A
Maximum Non-Detect	5.9	N/A
Percent Non detects	5.00%	0.00%
Minimum Detected	1.86	9.7
Maximum Detected	1330	2230
Mean of Detected Data	56.14	163.4
Median of Detected Data	20.85	22.35
SD of Detected Data	111.9	492

Site vs Background Gehan Test

H0: Mu of Site or AOC >= Mu of background 160

Gehan z Test Value	-6.584
Critical z (0.90)	-1.282
P-Value	2.29E-11

Conclusion with Alpha = 0.10

Reject H0, Conclude Site < Background + 160.00

P-Value < alpha (0.1)

```
------------------------------------------------------------------------------------------
    ---------------------
       log:  J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
           Background Evaluation\SS
> .smcl
  log type:  smcl
 opened on:  14 Oct 2008, 16:07:10

. edit
(1 var, 199 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
- preserve

. bysort AREA: centile aluminum, centile (50, 84.13)

_______________________________________________________________________________
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |      27          50        12600        6934.586    15303.38
             |               84.13     17690.24        15308.04    31677.48

_______________________________________________________________________________
-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |      18          50         8215        6542.824    10766.05
             |               84.13     15198.47        9639.242      19200*

* Lower (upper) confidence limit held at minimum (maximum) of sample

_______________________________________________________________________________
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |      11          50         7350        4511.164    12800.55
             |               84.13     13465.86        7712.518      17400*

* Lower (upper) confidence limit held at minimum (maximum) of sample

_______________________________________________________________________________
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |     121          50        16700        15442.04    19115.92
             |               84.13     28363.86        26810.42    32106.63

. bysort AREA: centile arsenic, centile (50, 84.13)

_______________________________________________________________________________
-> AREA = AOC 13
```

```
                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |        27         50           6.9       5.786464    8.053384
             |               84.13      10.61128       8.058042    13.71063
```

```
-------------------------------------------------------------------------------
-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |        18         50          6.39       5.499714    11.04151
             |               84.13      12.49694       9.664818       14.3*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |        11         50          10.9       7.340364      34.328
             |               84.13      43.26724       12.86606       68.5*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |       121         50           8.7       7.306306         9.1
             |               84.13      11.96386       11.11042    15.28513

. bysort AREA: centile  iron, centile (50, 84.13)

-------------------------------------------------------------------------------
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |        27         50         15000       13072.93    21147.38
             |               84.13       25067.3       21212.58    134401.1

-------------------------------------------------------------------------------
-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |        18         50         24250       15197.14    45737.82
             |               84.13       54923.5       39168.88      69200*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |        11         50         17400       14513.82    22805.45
```

```
             |                 84.13     35500.52        18450.24     132000*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |     121          50        27100        23321.02    36805.73
             |               84.13     87247.02        73041.67    109553.8

. bysort AREA: centile  lead, centile (50, 84.13)

-------------------------------------------------------------------------------
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |      27          50         20.3         14.2797    30.39475
             |               84.13     49.76552        30.52516    426.1159

-------------------------------------------------------------------------------
-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |      17          50         66.3        26.77862    128.5748
             |               84.13     298.1586        84.52897        341*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |      11          50         42.5        15.85527    131.9222
             |               84.13     418.4868        58.95316       2230*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |     121          50         25.6        21.16306    42.54268
             |               84.13     131.6386        88.64586    183.5538

. bysort AREA: centile manganese, centile (50, 84.13)

-------------------------------------------------------------------------------
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
   manganese |      27          50          755        433.9171    887.0099
             |               84.13     1673.809        906.2921    3580.521
```

```
-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
   manganese |        18          50        804.5        491.7731    1187.832
             |                 84.13     2439.596          1041.8       3180*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
   manganese |        11          50          820        498.5418    897.5709
             |                 84.13     1058.104        858.5815       2270*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
   manganese |       121          50         2160        1660.509    3225.287
             |                 84.13     5018.316        4541.042    5718.764

. bysort AREA: centile  vanadium, centile (50, 84.13)

-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    vanadium |        27          50         18.1        16.39323    25.73688
             |                 84.13     35.63384        26.06291    44.70733

-> AREA = AOC 22

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    vanadium |        18          50           15        11.24807    20.44437
             |                 84.13     24.59694        18.94844       30.5*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    vanadium |        11          50         21.2        11.97018    30.12291
             |                 84.13     31.20152        24.39769         35*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-> AREA = S. Exposure Area Rev
```

```
                                                          -- Binom. Interp. --
    Variable |       Obs  Percentile       Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    vanadium |       121          50          25.6        22.02102    28.17898
             |                 84.13      41.32772        37.95209    45.77025

. bysort AREA: centile  bapte, centile (50, 84.13)

_______________________________________________________________________________
-> AREA = AOC 13

                                                          -- Binom. Interp. --
    Variable |       Obs  Percentile       Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
       bapte |        27          50        .90129        .4849347     1.64244
             |                 84.13      13.81089        1.719982    50.98923

_______________________________________________________________________________
-> AREA = AOC 22

                                                          -- Binom. Interp. --
    Variable |       Obs  Percentile       Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
       bapte |        18          50       1.26282        .6247859    2.631954
             |                 84.13       36.4631        2.040069    52.7858*

* Lower (upper) confidence limit held at minimum (maximum) of sample

_______________________________________________________________________________
-> AREA = Background

                                                          -- Binom. Interp. --
    Variable |       Obs  Percentile       Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
       bapte |        10          50       1.04144        .3475199     3.66306
             |                 84.13      5.394327        1.232003    10.4325*

* Lower (upper) confidence limit held at minimum (maximum) of sample

_______________________________________________________________________________
-> AREA = S. Exposure Area Rev

                                                          -- Binom. Interp. --
    Variable |       Obs  Percentile       Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
       bapte |       119          50       .953285        .7749577    1.313507
             |                 84.13      5.599589        3.610209    8.281048

. edit
- preserve

. save "J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
    Background Evaluation\SS.dta"
file J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background
    Evaluation\SS.dta sav
> ed
. log close
       log:  J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
           Background Evaluation\SS
> .smcl
  log type:  smcl
 closed on:  14 Oct 2008, 16:12:46
-------------------------------------------------------------------------------------
    ---------------------
```

```
----------------------------------------------------------------------------------------------
      ---------------------
       log:  J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
           Background Evaluation\Co
> mbinedSoil.smcl
  log type:  smcl
 opened on:  15 Oct 2008, 08:44:41

. edit
(1 var, 199 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
(1 var, 198 obs pasted into editor)
- preserve

. bysort AREA: centile aluminum, centile (50, 84.13)

-> AREA = AOC 13

                                                        -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |        79          50        11800        7800.737       13100
             |                 84.13      21543.2        17351.16    23930.01


-> AREA = Background

                                                        -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |        20          50         8205          5038.2    12653.41
             |                 84.13     16267.87           12300       31600*

* Lower (upper) confidence limit held at minimum (maximum) of sample


-> AREA = S. Exposure Area Rev

                                                        -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
    aluminum |       240          50        14800        13465.28       16100
             |                 84.13     27601.32         25600.7       30300

. bysort AREA: centile arsenic, centile (50, 84.13)


-> AREA = AOC 13

                                                        -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |        79          50          6.4        5.654035    7.745965
             |                 84.13      11.5868         9.25116    13.54231


-> AREA = Background

                                                        -- Binom. Interp. --
    Variable |       Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
```

```
     arsenic |     20         50          9.75          7.8     14.46706
             |             84.13      34.20228     12.33964         68.5*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
     arsenic |    240         50           7.8              7          8.8
             |             84.13          11.8           11.2     13.10234

. bysort AREA: centile  iron, centile (50, 84.13)

-------------------------------------------------------------------------------
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |     79         50         14600       12627.02     17956.84
             |             84.13         29704       22002.32     40384.62

-------------------------------------------------------------------------------
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |     20         50         19400       17046.59     21730.12
             |             84.13       30971.1       21079.88      132000*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-------------------------------------------------------------------------------
-> AREA = S. Exposure Area Rev

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        iron |    240         50         23500       21161.13        25300
             |             84.13      71729.95       57205.64     85739.13

. bysort AREA: centile  lead, centile (50, 84.13)

-------------------------------------------------------------------------------
-> AREA = AOC 13

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |     79         50          16.3       12.42702     20.28649
             |             84.13       46.9264        30.4279     127.6487

-------------------------------------------------------------------------------
-> AREA = Background

                                                       -- Binom. Interp. --
    Variable |     Obs  Percentile      Centile        [95% Conf. Interval]
-------------+-------------------------------------------------------------
        lead |     20         50         22.35       15.13976     56.35941
             |             84.13      182.6178       49.69822        2230*

* Lower (upper) confidence limit held at minimum (maximum) of sample
```

-> AREA = S. Exposure Area Rev

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
lead	240	50	19.95	17.23057	22.2083
		84.13	83.2066	63.5141	123.9197

. bysort AREA: centile manganese, centile (50, 84.13)

-> AREA = AOC 13

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
manganese	79	50	636	455.214	797.8386
		84.13	2029.52	1418.602	2777.54

-> AREA = Background

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
manganese	20	50	722	515.2976	871.1365
		84.13	914.8622	849.5927	2270*

* Lower (upper) confidence limit held at minimum (maximum) of sample

-> AREA = S. Exposure Area Rev

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
manganese	240	50	1255	997.6113	1620.83
		84.13	4457.533	4120.564	4903.679

. bysort AREA: centile vanadium, centile (50, 84.13)

-> AREA = AOC 13

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
vanadium	79	50	17.1	15.01614	21.01088
		84.13	33.56	28.85116	39.49385

-> AREA = Background

Variable	Obs	Percentile	Centile	-- Binom. Interp. -- [95% Conf.	Interval]
vanadium	20	50	25.45	14.04259	30.68935
		84.13	35.06673	29.55971	59.3*

* Lower (upper) confidence limit held at minimum (maximum) of sample

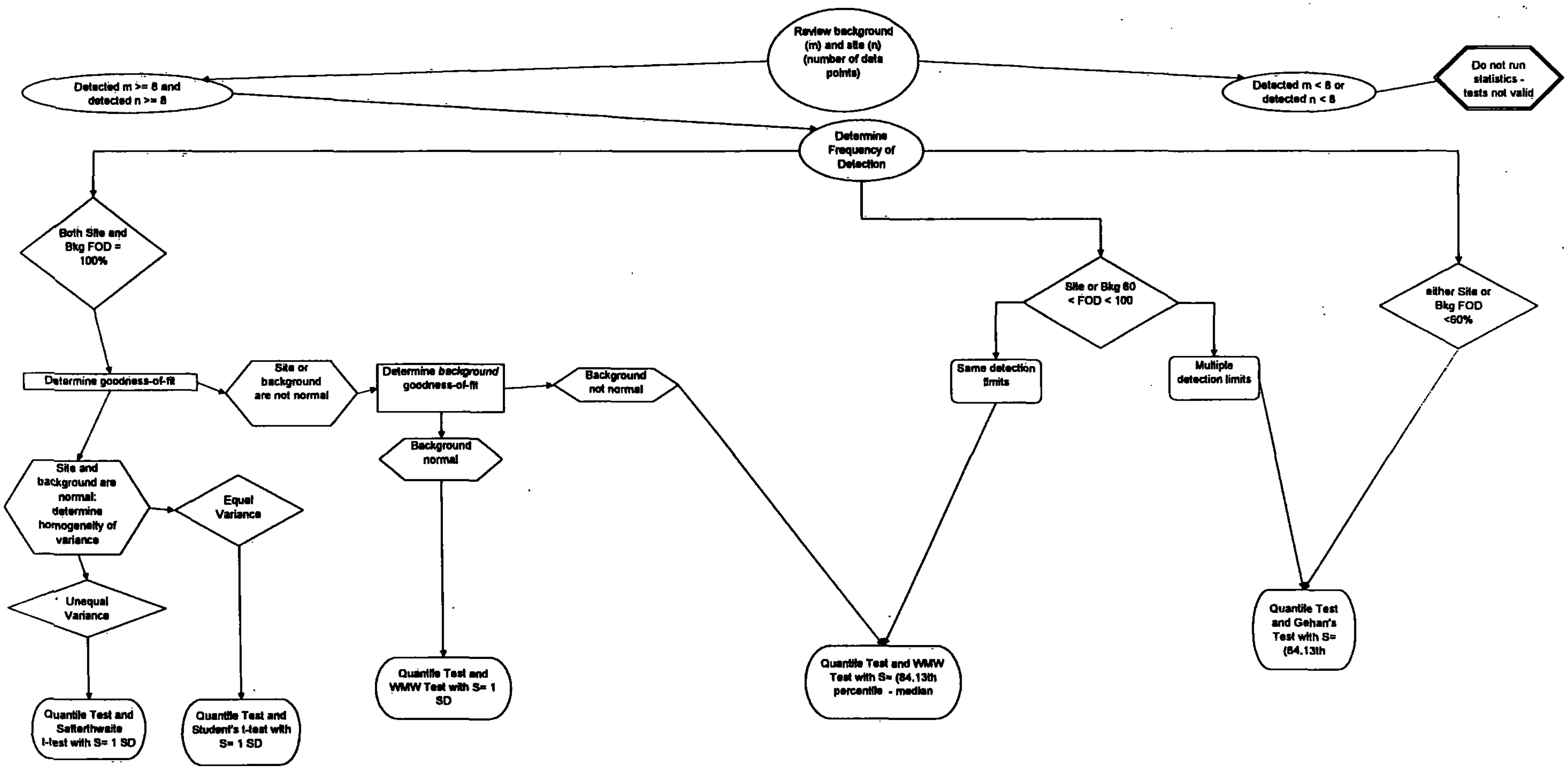
-> AREA = S. Exposure Area Rev

```
                                                       -- Binom. Interp. --
    Variable |       Obs  Percentile     Centile       [95% Conf. Interval]
-------------+-------------------------------------------------------------
    vanadium |       240         50        21.75              20       24.6
             |                84.13         39.7        36.10141   41.62074

. save "J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
    Background Evaluation\Combine
> dSoil.dta"
file J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\Background
    Evaluation\CombinedSo
> il.dta saved

. log close
       log:  J:\Indl_Service\Project Files\AKSteel (see Rem-Eng P00)\Hamilton, Ohio\HHRA\
              Background Evaluation\Co
> mbinedSoil.smcl
  log type:  smcl
 closed on:  15 Oct 2008, 08:47:18
---------------------------------------------------------------------------------------------
    ---------------------
```

Figure I-2 - Background Evaluation Hypothesis Test Selection Flow Chart



Notes:
n = Site sample size
m = Background sample size
SD - Standard Deviation.
WMW - Wilcoxon-Mann-Whitney.
FOD = Frequency of Detection.
Quantile Test uses Form 1
All other tests use Form 2

TABLE I-2a
POPULATION COMPARISON - AOC 13, AOC 22 (RIPARIAN AREA) AND SOUTHERN PARCEL SURFACE SOIL v. BACKGROUND SURFACE SOIL
BACKGROUND EVALUATION
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

Constituent	Site			Background			Validity of Background Evaluation? (a)	Distribution (b)		Parametric or Non-Parametric Test (c)	DL Review (d)	Tests to Run (e)				Basis of S (f)	S	Test Results: Quantile Test Results (H_0: Site <= Bkg)	F-Test (h)		Satterthwaite or Student's t-Test (H_0: Site >= Bkg+S)				WMW Test Results (H_0: Site >= Bkg+S)				Gehan Test Results (H_0: Site >= Bkg+S)				Conclusion: Are Site Data Consistent with Background? (j)
	Number of Detects	n	% FOD	Number of Detects	m	% FOD		Site	Background			Quantile Test	t-Test	WMW Test	Gehan Test			Reject H_0 and accept H_A: Site > Bkg)?	p-value	t-Test Used	t-Test Value	Critical t	Reject H_0 and accept H_A: Site < Bkg + S)?	p-value (g)	Test U-Stat	Critical Value	Reject H_0 and accept H_A: Site < Bkg + S)?	Approximate p-value (i)	z Test Value	Critical z	Reject H_0 and accept H_A: Site < Bkg + S)?	p-value (g)	
AOC 13																																	
Aluminum	27	27	100	11	11	100	Run Tests	Not Normal	Normal	Non-Parametric		X		X		(84.13-50) th %	6116	No							101	79	No	6.52E-02					No
Arsenic	27	27	100	11	11	100	Run Tests	Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	32	No							0	79	Yes	9.51E-07					Yes
Iron	27	27	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	18101	No							11	79	Yes	5.18E-06					Yes
Lead	27	27	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	376	No							8	79	Yes	3.30E-06					Yes
Manganese	27	27	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	238	No							99	79	No	5.74E-02					No
Vanadium	27	27	100	11	11	100	Run Tests	Not Normal	Normal	Non-Parametric		X		X		(84.13-50) th %	10	No							67	79	Yes	4.35E-03					Yes
BAP-TE	25	27	93	9	10	90	Run Tests	--	--	Non-Parametric	Multiple	X			X	(84.13-50) th %	4.4	No											-2.186	-1.282	Yes	1.44E-02	Yes
AOC 22																																	
Aluminum	18	18	100	11	11	100	Run Tests	Not Normal	Normal	Non-Parametric		X		X		(84.13-50) th %	6116	No							38	70	Yes	3.27E-03					Yes
Arsenic	18	18	100	11	11	100	Run Tests	Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	32	No							0	70	Yes	4.77E-06					Yes
Iron	18	18	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	18101	No							66	70	Yes	7.20E-02					Yes
Lead	17	17	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	376	No							0	66	Yes	6.08E-06					Yes
Manganese	18	18	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	238	No							77	70	No	1.67E-01					No
Vanadium	18	18	100	11	11	100	Run Tests	Normal	Normal	Parametric		X	X			1 SD	7.0	No	4.67E-01	Pooled	-4.112	2.7E+308	Yes	0.00E+00									Yes
BAP-TE	18	18	100	9	10	90	Run Tests	--	--	Non-Parametric	Equal	X		X		(84.13-50) th %	4.4	No							37	63	Yes	5.91E-03					Yes
Southern Parcel																																	
Aluminum	121	121	100	11	11	100	Run Tests	Not Normal	Normal	Non-Parametric		X		X		(84.13-50) th %	6116	Yes															No
Arsenic	113	121	93	11	11	100	Run Tests	--	--	Non-Parametric	Multiple	X			X	(84.13-50) th %	32	No											-5.485	-1.282	Yes	2.06E-08	Yes
Iron	121	121	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	18101	Yes															No
Lead	119	121	98	11	11	100	Run Tests	--	--	Non-Parametric	Multiple	X			X	(84.13-50) th %	376	No											-5.299	-1.282	Yes	5.84E-08	Yes
Manganese	121	121	100	11	11	100	Run Tests	Not Normal	Not Normal	Non-Parametric		X		X		(84.13-50) th %	238	Yes															No
Vanadium	121	121	100	11	11	100	Run Tests	Not Normal	Normal	Non-Parametric		X		X		(84.13-50) th %	10	Yes															No
BAP-TE	112	119	94	9	10	90	Run Tests	--	--	Non-Parametric	Multiple	X			X	(84.13-50) th %	4.4	NA (k)											-3.387	-1.282	Yes	3.54E-04	Yes

Notes:
BAP-TE - Benzo(a)Pyrene Toxicity Equivalent.
DL - Detection Limit.
FOD - Frequncy of Detection. Number of detected samples / Number of total samples.
H_A - Alternate Hypothesis.
H_o = - Null Hypothesis.
m - Background sample size.
n - Site sample size.
NC - Not calculated.
S - Substantial Difference.
SD - Standard Deviation.
WMW - Wilcoxon-Mann-Whitney Test.
(a) Hypothesis tests were not calculated if either the site or background data sets have less than 8 detected results.
(b) Distribution determined by ProUCL Goodness of Fit Test Statistics. Distribution was only analyzed if both the Site and Background data sets have FODs of 100%.
(c) If both the site and background data sets are normally distributed, a parametric t-test can be calculated. Otherwise, a non-parametric test is used.
(d) The detection limits were reviewed to determine whether the data sets have equal or multiple detection limits. Detection Limits were only reviewed if the Site or Background data sets had a FOD less than 100% but greater than 60%.
(e) The hypothesis tests were selected depending on the FOD, distribution, and detection limits. See Figure 1.
(f) If both background and site data are normally distributed and have FOD=100%, 1 standard deviation is used. If either site or background dataset has any nondetects or either dataset is not normal, the 84.13th - 50th percentile is used to approximate 1 standard deviation.
(g) The null hypothesis (Ho) was rejected when the calculated p-value was less than 0.1.
(h) The F-test tests for equality of the variances of the two data sets. If the variances are equal (p-value greater than 0.1), they are pooled together and a Student's t-test is used. If the variances are unequal (p-value less than 0.1), then the Satterthwaite's t-test is used.
(i) For the nonparametric WMW test, the p value is approximated. Therefore, the comparison of the calculated test statistic is compared to the test critical value to determine whether to reject the null hypothesis. If the U-statistic is less than the critical value, the null hypothesis is rejected.
(j) If the Quantile test rejects the null hypothesis and accepts the althernate hypothesis (H_A: Site > Bkg), then the Site data set is not consistent with Background. Otherwise, the results of the WMW or the Gehan tests are used. For either the WMW or the Gehan test, if the null hypothesis is accepted (H_o: Site >= Bkg + S), then the Site data set is not consistent with Background. If the WMW or Gehan test rejects the null hypothesis and accepts the alternate hypothesis (HA: Site < Bkg + S), then the Site data set is consistent with Background.
(k) Cannot complete the Quantile test; non-detect values in 'R' largest.

TABLE I-2b
BACKGROUND EVALUATION - AOC 13 AND SOUTHERN PARCEL COMBINED SOIL v. BACKGROUND COMBINED SOIL
ADDENDUM TO STATISTICAL EVALUATION OF BACKGROUND SOIL
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

Constituent	Site			Background			Validity of Background Evaluation? (a)	Distribution (b)		Parametric or Non-Parametric Test (c)	DL Review (d)	Tests to Run (e)			Basis of S (f)	S	Test Results									Conclusion: Are Site Data Consistent with Background? (i)
																	Quantile Test Results (H_0: Site <= Bkg)	WMW Test Results (H_0: Site >= Bkg + S)				Gehan Test Results (H_0: Site >= Bkg + S)				
	Number of Detects	n	% FOD	Number of Detects	m	% FOD		Site	Bkg			WMW Test	Gehan Test	Quantile Test			Reject H_0 and accept H_A: Site > Bkg)?	Test U-Stat	Critical Value	Reject H_0 and accept H_A: Site < Bkg + S)?	Approximate p value (g)	z Test Value	Critical z	Reject H_0 and accept H_A: Site < Bkg + S)?	p-value (h)	
AOC 13																										
Arsenic	78	79	99	20	20	100	Run Tests			Non-Parametric	Equal	X		X	(84.13-50) th %	24	No	(j)	(j)	(j)	(j)	-6.754	-1.282	Yes	7.19E-12	Yes
Lead	61	79	77	20	20	100	Run Tests			Non-Parametric	Multiple		X	X	(84.13-50) th %	160	No					-6.297	-1.282	Yes	1.62E-10	Yes
Southern Parcel																										
Arsenic	227	240	95	20	20	100	Run Tests			Non-Parametric	Multiple		X	X	(84.13-50) th %	24	No					-7.281	-1.282	Yes	1.66E-13	Yes
Lead	228	240	95	20	20	100	Run Tests			Non-Parametric	Multiple		X	X	(84.13-50) th %	160	No					-6.584	-1.282	Yes	2.29E-11	Yes

Notes:
DL - Detection Limit.
FOD - Frequncy of Detection. Number of detected samples / Number of total samples.
H_A - Alternate Hypothesis.
H_o = - Null Hypothesis.
m - Background sample size.
n - Site sample size.
NC - Not calculated.
S - Substantial Difference.
SD - Standard Deviation
WMW - Wilcoxon-Mann-Whitney Test.
(a) Hypothesis tests were not calculated if either the site or background data sets have less than 8 detected results.
(b) Distribution determined by ProUCL Goodness of Fit Test Statistics. Distribution was only analyzed if both the Site and Background data sets have FODs of 100%.
(c) If both the site and background data sets are normally distributed, a parametric t-test can be calculated. Otherwise, a non-parametric test is used.
(d) The detection limits were reviewed to determine whether the data sets have equal or multiple detection limits. Detection Limits were only reviewed if the Site or Background data sets had a FOD less than 100% but greater than 60%.
(e) The hypothesis tests were selected depending on the FOD, distribution, and detection limits. See Figure 1.
(f) If both background and site data are normally distributed and have FOD=100%, 1 standard deviation is used. If either site or background dataset has any nondetects or either dataset is not normal, the 84.13th - 50th percentile is used to approximate 1 SD.
(g) For the nonparametric WMW test, the p value is approximated. For the nonparametric WMW test, the p value is approximated. Therefore, the comparison of the calculated test statistic is compared to the test critical value to determine whether to reject the null hypothesis. If the U-statistic is less than the critical value, the null hypothesis is rejected.
(h) The hull hypothesis (Ho) was rejected when the calculated p-value was less than 0.1.
(i) If the Quantile test rejects the null hypothesis and accepts the althernate hypothesis (H_A: Site > Bkg), then the Site data set is not consistent with Background. Otherwise, the results of the WMW or the Gehan tests are used. For either the WMW or the Gehan test, if the null hypothesis is accepted (H_o: Site >= Bkg + S), then the Site data set is not consistent with Background. If the WMW or Gehan test rejects the null hypothesis and accepts the alternate hypothesis (HA: Site < Bkg + S), then the Site data set is consistent with Background.
(j) ProUCL does not give a result for the WMW test if background dataset contains all detected results and the site dataset has NDs; results for Gehan's Test shown.

TABLE I-4
SUMMARY RESULTS OF BACKGROUND EVALUATIONS (ORIGINAL AND ADDENDUM)
STATISTICAL EVALUTAION OF BACKGROUND SOIL
AK STEEL FORMER ARMCO HAMILTON PLANT
NEW MIAMI, BUTLER COUNTY, OHIO
BASELINE HUMAN HEALTH RISK ASSESSMENT

	Site Data Are Consistent with Background?															
	AOC 1 (b)		AOC 2 (b)		AOC 13 (a)		AOC 18 and AOC 21 (b)		AOC 19 (b)		AOC 22 (Riparian Area) (a)		Block A (b)		Southern Parcel (a)	
Constituent	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil	Surface Soil (0-2)	Combined Soil
Aluminum	No	NA	No	NA	No	NA	No	NA	No	NA	Yes	NC	No	NA	No	NA
Arsenic	Yes	NA	Yes	NA	Yes	Yes	Yes	NA	Yes	NA	Yes	NC	Yes	NA	Yes	Yes
Iron	No	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NC	No	NA	No	NA
Lead	NA	NA	NA	NA	Yes	Yes	NA	NA	NA	NA	Yes	NC	NA	NA	Yes	Yes
Manganese	No	NA	No	NA	No	NA	No	NA	Yes	NA	No	NC	No	NA	No	NA
Mercury	Yes	NA	Yes	NA	NA	NA	Yes	NA	Yes	NA	NA	NA	Yes	NA	NA	NA
Vanadium	No	NA	No	NA	Yes	NA	No	NA	No	NA	Yes	NC	No	NA	No	NA
BAP-TE	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NA	Yes	NC	Yes	NA	Yes	NA

Notes:
(a) Results from the Addendum to the Background Evaluation of Soil. The background evaluation was conducted using ProUCL 4.00.02 (USEPA, 2007) and Stata (Stata Corporation, 2003). For details of statistical analysis, see Table 1 (surface soil) and Table 2 (combined soil).
(b) Results from the original Background Evaluation of Soil.
NA - Not applicable. Constituents were not included in the background evaluation at in the specified human health exposure area and media.
NC - Not calculated. All soil samples in AOC 22 (Riparian Area) are surface soil.